KNOWLEDGE
AN ILLUSTRATED MAGAZINE OF SCIENCE, LITERATURE & ART.

Founded by RICHARD A. PROCTOR.

VOL. XXIV.] *LONDON: DECEMBER, 1901.* [No. 194.

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## EDITORIAL.

BEFORE proceeding to outline briefly our programme for the new year, the pleasing duty again devolves upon us of acknowledging our indebtedness to our Contributors for the very thorough manner in which they have enabled us to fulfil our promises, and to add still another volume of KNOWLEDGE to the series. To this expression of our thanks, we add an appreciation of the steady and increasing support which our Subscribers have given to our efforts to make KNOWLEDGE a trustworthy and popular medium of scientific thought.

In a day when the spread of science and literature has given the public a well-nigh limitless supply of new and remarkable facts, it is regrettable that the true meaning of these facts is too often hidden from the public view by the reserve of specialists. It is our earnest hope, therefore, that an increasing number of those who have it in their power to stimulate and satisfy the desire for a clear and definite perception of the worth and large issues of scientific discovery may be induced to do so.

The increasing public interest in the study of Astronomy, to which we referred last year, has been evidenced in the interest aroused by Mr. Maunder's comprehensive "Constellation Studies"; the concluding paper in this series will appear in the January issue, when the whole twelve studies, together with the previous series on "Astronomy without a Telescope," will be carefully revised by the Author prior to their issue as a volume in the KNOWLEDGE Library. Mr. Maunder is also engaged on a new series of papers dealing with some of the results of Spectrum Analysis.

Among the other Astronomical projects for which arrangements have been now completed, we may mention a descriptive account of the Starfield Observatory from the pen of Dr. Isaac Roberts, to whose work Astronomers are so much indebted; a paper on the Spectrum of Nova Persei, by the Rev. W. Sidgreaves, S.J.; and two articles from Mr. A. C. D. Crommelin, who proposes to deal with Eclipse Cycles, and with the actual path of the Moon in space. Further interesting contributions are promised by some writers new to our pages, and among these we may mention the Rev. T. E. Phillips on "The Currents of Jupiter's Atmosphere"; Professor R. A. Sampson on "The Almucantar of Durham Observatory," and on "The Mechanical Constitution of the Sun"; and Mr. Alexander Smith on "The Methods, Difficulties, and Results of Stellar Photography."

Mr. W. F. Denning will continue to contribute "Notes on Comets and Meteors"; while "The Face of the Sky" will appear month by month as heretofore, but will be edited during the coming year by Mr. W. Shackleton.

We are happy to welcome back to the pages of KNOWLEDGE an old friend in the person of Mr. E. A. Butler, who will commence in the January number a series of illustrated entomological articles. In Botany, Mr. R. Lloyd Praeger will contribute a new series of papers, of which the first will deal with "Plant Colonists"; and the Rev. Alex. S. Wilson will write on "Vegetable Mimicry." Much interest has been aroused during the past year by the Rev. J. M. Bacon's balloon expeditions, and Mr. Bacon has promised to write for us on "The Air above London," and on "The Clouds as seen from Cloud Level."

The Rev. T. R. R. Stebbing informs us that the fulfilment of his promise to write on some singular groups of *Arthropoda* may be regarded as still in view, the promise not forgotten, though the fulfilment has been deferred. Prof. Grenville A. J. Cole will return to our columns with an article on the great granite chain of south-east Ireland, "The Backbone of Leinster"; and he will also write on "The Plain of Prussia." Mr. Harry F. Witherby will record his experiences on an ornithological expedition to Russian Lapland. Contributions have also been promised by Mons. E. M. Antoniadi, Mr. R. Lydekker, Dr. Hugh Robert Mill, and other writers.

Mr. M. I. Cross will continue to conduct the Microscopy column. This subject could be made increasingly helpful and interesting by the co-operation of readers and workers, and notes and suggestions are invited. It is proposed at intervals to offer to readers of KNOWLEDGE material for mounting as microscopical slides, with instructions for the processes, and descriptions of the objects. It is hoped that readers will themselves contribute material for distribution with descriptions, and so add to the usefulness of the suggested scheme.

In the Chess Column, the Solution Tourney which Mr. Locock has conducted during the closing year has proved an unqualified success, and has induced Mr. Locock to project for the new year a three-move Problem Tourney and also a Solution Tourney to run concurrently with it. The particulars of both these contests will be found in the Chess Column.

It will be gathered from the foregoing that a large part of our volume for the coming year is provided for, but we are always glad to receive contributions considered suitable for our pages.

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# THE WHITE NILE—FROM KHARTOUM TO KAWA.

## AN ORNITHOLOGIST'S EXPERIENCES IN THE SOUDAN.

By HARRY F. WITHERBY, F.Z.S., M.B.O.U.

## VI.—A DANCE, A SAND-STORM, AND A RARE BIRD.

THE natives, generally, as I have mentioned, took little notice of us. One day, however, when out collecting, we met with a flattering reception from the inhabitants of a small village through which we passed. The men rushed up to us, seized our hands and kissed them repeatedly; while the women in the background gazed on us admiringly and loudly proclaimed their pleasure with the shrill "sachareet." The "sachareet" is a loud high-pitched trill, sounding like the syllable "la" uttered very rapidly and shrilly, and is used by the Soudanese women on all joyous occasions. We were somewhat overcome and greatly puzzled by this greeting, and suspected that it was due to something more practical than pure good nature. The country round the village proved a good collecting ground, and the next day we went there again, and as the place was some distance from our camp we carried luncheon with us. The natives seemed even more pleased to see us than they did the day before. However, as we were bent on collecting, we paid little attention to them, and leaving a couple of men to prepare luncheon in the shade of some thick bushes, we set out to hunt the surrounding country.

On returning in the heat of the day to the temporary camp amongst the bushes we found all the inhabitants of the village engaged in a dance. On our appearance the dance stopped, and our ears were split with the shrill sachareet; the natives crowded round, and we were nearly overpowered by the coarse and pungent odours from the pomades and scents with which the women plaster themselves, especially on festive occasions. Getting the crowd to stand off a little we asked our men the meaning of all this hubbub, and learnt that a wedding was shortly to take place in the village.

We were then led to an open space amongst the thick mimosas, and while the old men and children carefully cleared the sand of the long white thorns, the matrons arranged the scanty clothing of the young girls and made them ready for the dance. All being prepared, we sat down on the sand, and the natives arranged themselves in a semi-circle in front of us. Behind stood the old women, and in front of them the young men and girls; while the old men and children grouped themselves in various attitudes at each side. Of musical instruments there were none, not even a tom-tom, but time and incentive were given by a somewhat droning chant accompanied with clapping of hands. As yet there seemed no inclination to dance, and a nudging and pushing in the ring of singers indicated unwillingness on someone's part to perform—what woman does not understand the value of coquetry? At length a girl was pushed out of the ring, but she coyly darted back, only to be pushed out again. Then, standing upright for a moment, she began the dance. Putting one bare foot forward and throwing her head right back, with her full bosom thrust out and her hands on her hips, she slowly advanced, swaying from side to side and turning and moving her head in time to the music. Every movement was slow and careful as though the dance was a difficult balancing feat, and the performance reminded one of the strutting and nodding of an amorous pigeon. Behind the girl walked a young man, clapping his hands in time to the chant, while both he and the dancer uttered an extraordinary guttural grunting sound which seemed to arise from the very depths of the stomach. The girl stopped in front of us, and still swaying her body, gradually sank down at my feet, then, slowly rising, swished my face with her plaited, grease-soaked hair. Feeling considerably embarrassed, and not knowing what was expected of me, I asked my men quickly to tell me what to do, as the girl was preparing to repeat the perfumed swish. They told me to flick my fingers at her and bend my head to hers. Thankful that nothing more was expected, I did this as well as I could, and immediately all the women set up the shrill sachareet and the dancer returned to her place. Evidently I had done the right thing, but I believe one is also expected to damp a coin and place it on the dancer's forehead. The dance now became more general, several girls performing, and all of us being saluted. A gourd was then brought round and we were told that a collection was being made for the bride and bridegroom, who by the way were nowhere to be seen, the bride being carefully locked up until the wedding day, and the bridegroom being too bashful to appear. The gourd so far only contained a few beads. We contributed the little money which we had about us; but felt that the wedding presents were meagre. Our men gave nothing, although they immensely enjoyed the dance. Moreover, when pressed, they swore repeatedly and solemnly that they had no money.

These dances are kept up night after night for a week or so before a wedding. John Petherick, in his "Egypt, the Soudan and Central Africa," mentions that jars of merissa are supplied free to entertain the wedding guests. Our men told us that merissa was to be had in plenty during these times of gaiety, but that the visitors had to pay for it, and the knowledge of this fact and the handing round of the begging bowl somewhat detracted from the wild freedom of this primitive scene.

There are many curious customs in connection with marriage amongst the Soudanese. One of a primitive and savage nature was brought to our notice continually. At almost every camp young men were conducted to us to exhibit with great pride long raw wounds on their backs. In every case these wounds were made with the corbag and were inflicted at weddings. Part of the ceremony consists in the bridegroom standing erect and motionless while one of the party flicks pieces of flesh off his back with this deadly whip. Should he move or betray any sign of pain he is considered no man, everyone jeers at him and a crowd of contemptuous hags rush on him, their nails proving often worse to endure than the corbag.

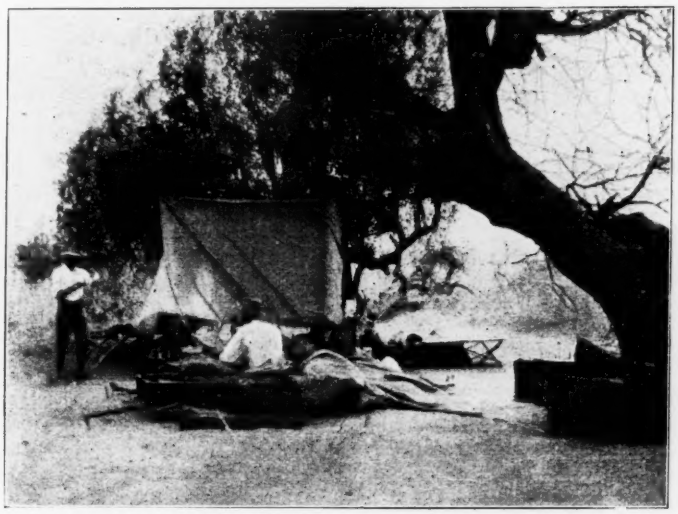
For two hours after we had got rid of the dancers an almost overpowering smell of ointment hung heavily in the air, and we were only too glad to cut short our mid-day rest and resume collecting. Hearing at some distance a loud wild whistle somewhat like that of a buzzard, I followed up the sound and tried to get near the bird that made it. But it was a long chase. The country was fairly open and the bird very shy, so that it managed easily to watch me and with heavy dipping flight to keep well out of range. At length, however, a wooded place gave me the advantage, and after a short stalk I secured the bird, which proved to be a dark-coloured hornbill.* Most of the hornbills, as is well known, are characterised by an exceedingly large bill, the upper part of which is thickened to such an extent

* *Lophoceros nasutus* (Linn.).

as to form a sort of casque, and the whole is usually brilliantly coloured. The bird I had just secured had a large heavy curved bill, but the casque was small and scarcely noticeable, while in colour the bill was black. A smaller species† of hornbill, which was fairly common in the district, also had a comparatively slender bill, but coloured more brightly with red, black and yellow.

These curious birds were, unfortunately, not breeding at the time of our visit, so that we were unable to observe the remarkable habits, shared, I believe, by all the hornbills, of imprisoning the female in the hole of the tree in which the eggs are laid. When the female begins to sit the male proceeds to plaster up the entrance to the nest with a gummy secretion, and his mate is no unwilling party to this arrangement, for she actually helps him in the work. It is probable that while she is sitting she loses all her wing feathers and is thus incapable of flight. If such be the case her prison may well become a fortress, where she is safe from the attacks of monitors and other enemies. A crack is left open in the plaster door and through this the male feeds the female and the young. Even more remarkable than the imprisonment of the female is the fact discovered by the late A. D. Bartlett, that at a certain period of the year hornbills cast the lining of their gizzards. The lining is formed by a secretion, and takes the shape of a bag, the mouth of which is closely folded. When cast up the bag contains the fruit which the bird has been eating, and it is supposed that this process enables the male to provide his mate more easily with food.

The pursuit of the hornbill had led me far from the camp, and the keenness of the chase had made me oblivious to a dark heavy cloud on the horizon. I knew well what the cloud meant. It drew rapidly nearer and I walked quickly on, but was still some way from the tents when there was a sudden roar of wind, then fell darkness, and the air, laden with sand, became blinding and suffocating, blotting out the country like a thick mist. To try and proceed meant losing oneself in this fog of sand. To face the wind was to court blindness, and there was nothing to be done but to crouch down back to the driving cutting sand and wait for the storm to clear. Gradually the air got clearer, and with the darkness gone, but with much sand still blowing, I made my way to camp. The storm produced the usual uncomfortable results: clothes and body seemed saturated with grit; boxes and trunks, how ever tightly closed, were filled with sand, and meat and drink that night were thickly seasoned with it. When a storm was accompanied by a heavy rush of wind the results were more annoying. Clothes and papers were scattered, and once my tent blew down with a run, burying my camera and myself in the ruins. The only benefit bestowed by a sand-storm was an occasional cool wind which followed, but this was, unfortunately, rare, and scarcely compensated for the two or three hours of misery the storm entailed.



The Wreck of a Tent. Waiting for the Sandstorm to clear.

As a rule an approaching dust-storm appeared merely as a thick murky cloud, but once from the top of Gebel Auli we witnessed a storm advancing upon us over the desert like a huge tidal wave. Towering some two or three hundred feet in the air, and stretching away almost to the horizon on either side, the great wave curved like a gigantic bow. Its centre was a shapeless mass of inky blackness, but where the bow curved and the brilliant sun lighted up the wave in profile, its form was as compact, well defined, and rounded as any Atlantic breaker, and its colour of a rich deep yellow. Rolling over and over and advancing slowly but certainly it seemed as though it might sweep everything from the face of the earth. In front all was bright and peaceful, behind all was dark and gloomy. Suddenly we heard the roar of the wind, a few moments more and the wave was on us, its outline faded and we were engulfed in the thick darkness and driving sand. An hour or two afterwards we emerged from the shelter of a rock and made our way to camp, and all that night we slept in a wind that was delightfully cool but heavily charged with sand.

Sand-spouts, dust devils, or "cock-eyed-bobs" were other forms of sand-storms which caused us much amusement. A little whirlwind suddenly starts in the desert raising a small column of dust. The column whirling spirally upwards rapidly increases both in height and circumference. Then it begins to move along and at length tears madly across the plain as if alive, gathering pace and volume as it goes and whirling aloft every loose thing it encounters. At all hours of the day these spiral columns of sand race over the desert, stopping here and there, then rushing on again. They vary as much in their size as in their direction. Sometimes two will meet each other, and if they be well matched the collision stops them, and a struggle ensues as to which way they shall twist. Gradually one gains the mastery, and the two combined begin to gyrate alike and then rush on together. A dust devil comes on you unawares and sweeps off your hat and an Arab's clothes. I have seen one twist a goat round like a top, and our camel-men were once attacked and their loose clothes swept off, while we, only fifty yards away, heard the roar but felt not a breath of wind.

The wildness, the freedom, and the limitless extent of the desert all have their charms, the scent of its heated breezes is fascinating, while its very barrenness has an intense interest. Compare the vegetation of a

† *Lophoceros erythrorhyncus* (Temm.).

desert to that of a well-watered country. In the desert the plants fight for life against the want of moisture; they are thinly spread, stunted, with small leaves or no leaves, spiky or hairy, every contrivance being made use of to prevent transpiration and to retain moisture. In the watered country the plants fight against one another, they crowd each other out, and the most luxuriant gains the mastery. In the desert you can read in the sand as in clearest print and see the scarcity of its animal life. Bordering on the watered country the tracks are fairly numerous, but the further you go the fewer become the feet-marks until those of sand-grouse and a few other birds with here and there a run of some small animal are all the marks to be seen.

One afternoon while wandering about the fringe of the desert I came upon some tracks made by small birds which seemed to be great runners. I followed up the spoor until it disappeared, evidently where the birds had taken to flight. Going on and casting about I found the tracks again and eventually got a sight of some sandy-coloured babblers‡ running swiftly along the ground. When I neared them they uttered a shrill "whee" quickly several times, then rose and flew straight and low, alighting some little way off. After hunting them a long time and getting no nearer, I at last drove them into some thick leafless bushes. I could see them from the distance with my binoculars perched in the bushes and flirting their tails up and down like wagtails, but when I got near they had disappeared. Then I heard a shrill note coming from the middle of a bush which was composed of thin and wiry green shoots, leafless but so thickly interlaced that the birds were perfectly hidden. I kicked the bush, but the birds would not budge. I walked all round it several times but the birds only travelled round on the opposite side. When I was least expecting it the babblers flew out suddenly and silently, and were hidden in a neighbouring bush before I could get a view of them. By employing dodging tactics somewhat like hunting a person round a table I managed to secure two or three specimens.

The chase ended, I began to realise that six or eight miles of desert divided me from the river; that I had no water bottle and was parched with thirst. The east grew dark, and turning round, I saw the sun quickly dipping below the horizon. I hurried to the river but had not gone a mile before the sun sank, and the light rapidly drawing itself together, plunged down after it, the landmarks disappeared, and I was left without a guide. I trudged on and luckily keeping my direction fairly well, at length reached the trees. After a long search I found the camp, but was then nearly speechless with thickened tongue and parched-up throat. Such a condition was uncomfortable enough, and gave one a slight idea of the agonies suffered by those who die of thirst in the fiery heat of the desert.

The chief object of this walk in the desert was to search for a rare and beautiful goatsucker.§ Only four specimens of this bird were known and they had been brought home many years ago; three by Rüppell and one by either Schimper or Baron von Müller. The exact locality from which they came was uncertain, but it was known to be from somewhere in the Sennaar district. Consequently the bird was one of our possible prizes and was hunted for accordingly. The plumage of the head and back of this lovely goatsucker is like burnished gold with small spots and bars of black and grey, while the breast is buff coloured. A bird of such colouring should evidently live amongst yellow sand, but the desert for the most part of the country we traversed was of a gritty grey colour. It was not until we were within twelve miles of Khartoum on our return that we found the desert of a colour to match the goatsucker. But all our search was useless. The goatsucker was not to be found by tramping over the burning sand. Then good fortune came to our aid.

There is just a short half-hour after sunset when the bats begin to fly and one can see to shoot them against the fast waning light in the west. On one of our last evenings of camp life I was trying to shoot some small bats that were flitting round the tents. The first that dropped I failed to find in the darkness, so I marked the place where it seemed to fall by a small pyramid of mud. By this time the sun's glow had faded, but a brilliant moon had risen, and thinking I should be able to see the bats flying over the water, I moved down to the edge of the river. As I was standing there a hawk-like bird appeared like a ghost from over the river. As it passed me I raised my gun mechanically and fired, but the bird went on and in ten yards or so was out of sight. I thought no more about it as my gun was loaded with dust shot and the bird seemed large and some distance off. Tiring at length of shooting by moonlight I returned to the camp, and calling for a lantern, went to search for the bat at the place I had marked with a heap of mud. As the light flashed on the spot, there lying dead with outspread wings was the glorious golden goatsucker. I picked it up and rushed madly to my companions. The Arabs looked on in wonder at three frantic Englishmen dancing and shouting round a bird. It was one of those rare occasions in a naturalist's camp when champagne would seem a necessity. Having none we drank to the goatsucker in whisky and White Nile water.

That night we heard a goatsucker "churring." We hoped it might be a golden one, but could detect no difference in its note to that of the common goatsucker of the country, which rasped continually like some huge locust in the trees about our camps. Needless to say in the few days before we reached Khartoum and began our rush home to England, we redoubled our efforts to find more of so rare a bird, but not a sign of another did we see. In a country made easily accessible by rail such a bird cannot be expected to remain rare long, and this year, near Shendy, the Hon. Charles Rothschild and Mr. A. F. R. Wollaston found this goatsucker fairly common, and brought home some fifteen specimens.

The fate of the bat that led to the finding of the goatsucker must be told. In the morning I searched carefully and found it. Strangely enough it was of much the same colour as the goatsucker, and on bringing it home Mr. W. E. de Winton pronounced it a new species. My friend, Capt. S. S. Flower, however, afterwards brought home a similar specimen which he had obtained two months before I shot mine, and some 200 miles further to the south. Capt. Flower's specimen therefore rightly took precedence, and the bat has been named *Glauconycteris Floweri*.

I often dream of a broad river flowing through a desert land lit by the bright moon; of a ghost-like form and a chance shot; then I see a stately Arab bearing a lantern, and suddenly the light flashes upon a glorious bird shining like burnished gold all spread out upon the sand.

‡ *Argya acaciæ* (Licht.). § *Caprimulgus eximius* Temm.

# A REMARKABLE MAMMAL.

By R. LYDEKKER.

MY readers are not to imagine that the animal whose portrait appears in this number of KNOWLEDGE is one new to science, or even one whose structure has hitherto been imperfectly known. On the contrary, it has been known to science for nearly a century and a quarter; but it is altogether such a peculiar and interesting creature that it may well form the text of an article in this journal.

Like so many of its cousins the lemurs, the aye-aye is an inhabitant of Madagascar, from the west coast of which island the first specimen known to European science was brought to Paris in 1780 by the French traveller Sonnerat, who discovered several other curious mammals and birds. By the naturalists of that time, despite the remarkable peculiarity in the structure of the fore-paws mentioned later on in this article, it was regarded as a squirrel, and accordingly named *Sciurus madagascariensis*. It was, however, soon after apparent that, whatever might be its real affinities, it could not rightly be retained in the same genus as the true squirrels; and it was accordingly renamed, at first *Daubentonia*, and subsequently *Chiromys* (*Cheiromys*). The justification for the proposal of this second title was that the first had been previously employed in botany, which was then (although not now) regarded as a bar to its use in zoology. And at the present day some naturalists think that the almost forgotten *Daubentonia* ought to be resuscitated, and the familiar *Chiromys* abolished. This, however, is a matter which may be left for the specialists to settle among themselves.

But it is not with regard to its scientific name alone that the creature has been unfortunate; a difference of opinion having arisen as to its right to the name "aye-aye," by which it has been universally known since Sonnerat's time. That traveller, it appears, had at first two living specimens obtained on the west coast of Madagascar; and when these were seen by the natives of the east coast (where the species is unknown), they ejaculated "aye-aye"—or more probably "hai-hai"—which seems, not unnaturally, to have been regarded as the native name of the animal. At least as early as 1860 it was, however, suggested that in place of being the animal's name, it was merely an exclamation of surprise at the sight of a strange and unknown creature. And this view of the case is maintained to be correct by Mr. Shaw, a missionary who resided for many years in Madagascar. On the other hand, another missionary, Mr. Baron, affirms that the name "hai-hai" is derived from the creature's peculiar cry.

When those who have the best opportunities for deciding arrive at such opposite conclusions it is difficult for others to form a judgment. I have, however, consulted a naturalist familiar with Madagascar, who tells me that "hai" is undoubtedly the Malagasy expression of surprise or wonderment. And that as the aye-aye is a shy and rare creature, seldom seen even by the natives of the districts where it is found, and then regarded with superstitious awe, the colloquial expression of wonderment may well have become its accepted name. If, however, "hai-hai" be, as Mr. Baron asserts, the creature's own cry, then it would seem more likely that the exclamation has been derived from the animal, and not that the animal has taken its name from the exclamation. Anyway, there seems undoubtedly to be some kind of connection between the exclamation "hai-hai" and the name "aye-aye," and we may therefore be content to accept the latter as the popular title for *Chiromys madagascariensis*. The naturalist to whom allusion is made above tells me, however, that the creature certainly has another vernacular title in some parts of the island.

As already mentioned, the naturalist Gmelin, by whom the aye-aye was originally described, regarded it as a kind of squirrel—an opinion shared at first by the great anatomist Cuvier. This view of its relationship was doubtless formed from the somewhat squirrel-like appearance of the animal, and the approximation made by its teeth to the rodent type. When, however, the Paris specimen was more carefully examined, and its skull and certain other bones removed from the skin, it became apparent that its relationships were evidently with the lemurs; the German naturalist Schreber being the one to whom the honour of this identification is due.

From Schreber's time till 1860 little or nothing more was done to advance our knowledge of the aye-aye, of which the Paris specimen remained the only example in Europe. In 1858, however, Dr. Sandwith left England for Madagascar, and previous to his departure Sir Richard (then Professor) Owen impressed upon him the importance of endeavouring to obtain specimens of this rare animal. A year later the Professor received a letter stating that, with much difficulty a specimen had been secured; and this in due course arrived in England preserved in spirit. It was dissected and described by Owen in 1860; and from the beautiful drawing by Wolf which accompanies that memoir the figure illustrating the present article is reproduced.

Soon after the arrival of the specimen sent to Owen a living example of this strange animal was received at the menagerie of the Zoological Society in Regent's Park; this being a female presented in 1862 by Mr. E. Mellish. An excellent account of the habits of this animal in captivity was published by the late Mr. A. D. Bartlett in the Society's *Proceedings* for the same year. A male and female were also received in the menagerie in the summer of 1883, while a fourth specimen was purchased in the autumn of 1887.

The ordinary public saw, however, little or nothing of these specimens, for as might be inferred by its large eyes, the aye-aye is essentially a nocturnal creature, remaining comfortably curled up during the daylight hours, and only venturing out as the darkness comes on. In this respect it resembles the majority of its cousins, the lemurs; and were we naming animals afresh, the title lemur would in some ways have been more appropriate to this particular species than to those to which it properly belongs. For the word "lemur" in its original signification means a ghost, and not only is the aye-aye stealthy and ghost-like in its movements, but it is regarded with superstitious dread by the Malagasy, who believe it to be a kind of spirit.

As already mentioned, the aye-aye has somewhat the appearance of a large dark-coloured squirrel; and in size it may be compared roughly to a cat, the total length being about three feet. The head and face are short and rounded; and the large eyes are furnished with a membrane which can be drawn across them from one side. The large and rounded ears, which are inclined backwards, are naked and dotted with a number of small tubercles. The blackish-brown hair all over the body is long and coarse, but it becomes longer still on the long and bushy tail. Nothing very remarkable exists in the structure of the hind limbs, which somewhat exceed the front pair in length; but the fore-paws, or hands, which are unusually elongated, display

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a most strange peculiarity. As in lemurs generally, the thumb is capable of being opposed to the index finger, which is short; the latter, together with the fourth and fifth digits, being of normal thickness and provided with long compressed and pointed claws. The third, or middle finger, as is beautifully shown in the plate, is, however, quite unlike the others, being extremely thin and spider-like. Of its use, mention will be made later.

This attenuated middle finger is one of two marked peculiarities whereby the aye-aye differs so strongly from its relatives, the true lemurs. Its other peculiarity is to be found in its dentition. Ordinary lemurs, it may be observed, have from 32 to 36 teeth; the incisor, or front teeth, although presenting certain peculiarities of form, agreeing numerically with those of monkeys and man in most cases. In the aye-aye, however, there are only 18 teeth, all told; the incisors being reduced to a single pair in each jaw, the canines, or tusks, wanting, and the cheek-teeth, or grinders, comprising four pairs in the upper and three in the lower jaw. Nor is this all, for the incisors, which grow throughout life, are large somewhat chisel-like teeth, recalling in many respects those of the beaver, or other rodents, although with peculiarities of their own which render them easily distinguishable from those of all the members of that group. Still, the whole character of the dentition is so essentially rodent-like that there is little wonder the old naturalists regarded the aye-aye as a near relative of the squirrels.

The general anatomy of the aye-aye, especially the structure of its skull, shows, however, that it is certainly a near relative of the lemurs, themselves distant cousins of the monkeys, from which, among many other peculiarities, they differ by their expressionless, fox-like faces. The aye-aye is therefore classed as a lemuroid; of which group, owing to the peculiar character of its dentition and its attenuated middle finger, it must be regarded as a highly aberrant and specialised member.

Unfortunately, in spite of recent explorations in the superficial deposits of Madagascar, where bones of huge extinct lemuroids have been disinterred, nothing whatever is known as to the ancestry of the aye-aye. Evidently, however, it must be a comparatively ancient type, for, if we may judge from the analogy of other groups, a long period of time must have been required to allow of the gradual evolution and development of its characteristic peculiarities of dental and manual structure.

Clearly these peculiarities must be connected with its mode of life. And we learn from those who have observed the creature in its native forests or in captivity, that the aye-aye, unlike the true lemurs, subsists largely upon wood-boring insect larvæ, especially on the larva of a beetle known to the Malagasy by the name of andraitra. Apparently the aye-aye possesses a sense of hearing so acute that when on a bough it can detect the faint rasping sound made by the jaws of the andraitra as it bores its way through the wood in the interior. Thereupon it at once sets to work with its powerful front teeth to chisel away the intervening wood till it opens up the tunnel of the burrowing larva. As soon as the tunnel is opened up the attenuated middle finger is thrust in, either to act as a probe to determine the position of the larva, or to drag it out from its hiding place, or perhaps for both purposes. Some uncertainty still obtains as to the exact details of these and other operations of a like nature, for our information on these points appears to be mainly, if not exclusively, based on native accounts. There is, however, little doubt that the *modus operandi* is in the main as described above.

We thus have a sufficient and satisfactory explanation of the reason why the aye-aye differs so remarkably in its dentition and in the structure of its hand from all its living kindred. If, however, we attempt to account for the gradual development of these peculiarities by what is commonly called natural selection, we encounter considerable difficulty. It is easy to conceive how the ancestors of the horse may have lost their lateral toes by disuse, but how an ancestral aye-aye gradually reduced the size of its middle finger till it assumed the attenuated proportions of its existing representative is very hard to understand, seeing that a slight diminution in the calibre of this digit would be of little or no advantage. Some much more potent cause than "natural selection" seems necessary in this, as in many other instances.

As regards its general mode of life, the aye-aye wanders through the silent forests at night in pairs, and never appears to associate with others of its fellows than its partner. Probably the partnership is for life, but on this point we have no definite information. The aye-aye is one of the comparatively few mammals which build a regular nest; this being constructed, according to Mr. Baron, of the carefully rolled up leaves of one particular kind of tree, and lined with small twigs and dry leaves; the whole structure having a diameter of about a couple of feet. Apparently the sole use of this nest is a nursery, and in it at the proper season the female brings forth a solitary offspring; whether born naked or clothed with hair does not seem to be ascertained. The female alone builds the nest, which is placed securely in the fork of a tree. In addition to the use described above, the attenuated middle finger is employed to comb the hair and clean the eyes, mouth, and nose; when thus engaged the animal generally suspending itself head-downwards from a bough by its hind-feet—at any rate, this is the case in captivity. Generally the food is not held in the paws after the usual monkey and lemur fashion, although the act of drinking is performed in an ape-like manner, the fingers being first dipped in water and then sucked.

In addition to the boring larvæ already alluded to, it is certain that the aye-aye will eat various other kinds of food, although native accounts differ to a considerable extent on this point. Some say, for instance, that it subsists largely on birds and their eggs, while others assert that honey is its favourite food. Probably there is some degree of truth in all these accounts, and that the creature is to a certain extent omnivorous. It will eat sugar-cane with considerable gusto, and in captivity has been known to take bananas. But that these latter are not its natural food would seem to be evident from the fact that they stick in and clog its teeth.

As regards its distribution, the aye-aye is a very local animal; its chief habitat being the great forest clothing the eastern border of the great central plateau of the island. Here, however, it is apparently restricted to the district forming the confines of the provinces of Sihanaka and Betsimisaraka, which is situate about five-and-twenty miles inland in latitude 17° 22' S. I am, however, informed by the friend mentioned above that an aye-aye occurs in the south of the island, which, if its habitat is isolated from that of the typical form may turn out to be a new local race, or possibly even a distinct species.

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**HEAD AND FORE-QUARTERS OF THE AYE-AYE,**

**The Most Remarkable of the Malagasy Lemuroids.**

From the Drawing by Wolf, published in the *Transactions of the Zoological Society of London.*

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Although the aye-aye is certainly far from being a common animal, yet it is probably less rare than is often supposed. Its supposed great rarity appears to be largely due to the dread in which it is held by the natives, who can seldom be induced to capture a specimen. It is believed to be endowed with the power of causing the death of those who attempt its capture, and it is consequently only some of the bolder natives who will venture on this undertaking, and then only after providing themselves with a charm to counteract the effects of the creature's supposed supernatural power. Occasionally, according to Mr. Baron's account, it is taken in traps set for lemurs; but it is then, unless the owner is possessed of the aforesaid charm, invariably set at liberty, after being anointed with fat in order to propitiate its goodwill and forgiveness. Only very occasionally is a specimen offered for sale in the market at Tamatave, when a good price—presumably from Europeans—is always obtained.

## THE REAL PATHS OF FIREBALLS AND SHOOTING STARS.

By W. F. DENNING, F.R.A.S.

DURING the fifteen years from 1886 to 1901 the real paths of 300 fireballs and shooting stars were computed by the writer. The observations were principally made at Bristol, at Slough by Prof. A. S. Herschel, and at Bridgwater by Mr. H. Corder. Simultaneous watches of the sky were arranged between these and several other observers in various parts of the country for the special purpose of obtaining duplicate records of identical meteors, and those who participated in the work having been habitually engaged in this field, it is thought the data which have accrued may be regarded as fairly accurate. Most of the results of individual path-computations have been already published in the Journals of the Liverpool Astronomical Society (1887-9) and British Astronomical Association (1892-1901), the work having been in part undertaken in connection with the meteoric sections of the societies named.

I have been arranging and classifying the results with the object of deriving mean values for the various kinds of meteors, as the materials appear to be sufficiently ample to allow figures to be arrived at which, if not conclusive and final, will at least approximately represent the facts and possibly lead the way to a more thorough investigation at a future time when many thousands instead of a few hundreds of trustworthy observations of this kind have accumulated. The mean heights, etc., are summarized in the following table:—

| | Mean height at beginning. | Mean height at ending. | Mean length of path. | Mean velocity per sec. | Mean altitude of radiant. | No. in diagram. |
|---|---|---|---|---|---|---|
| FIREBALLS— | Miles. | Miles. | Miles. | Miles. | Degs. | |
| Very swift, with streaks, Perseids, Orionids, Leonids, &c. | 85·2 | 50·0 | 55·0 | 37·5 | 39 | 1 |
| Moderately slow, with tolerably high radiants | 71·7 | 23·3 | 84·0 | 18·3 | 35 | 2 |
| Slow-moving, low radiants | 58·4 | 26·0 | 116·0 | 14·6 | 16 | 3 |
| Slow-moving, radiants close to horizon | 58·4 | 47·6 | 121·4 | 13·0 | 5 | 4 |
| SHOOTING STARS— | | | | | | |
| Very swift, with streaks, Perseids, Orionids, Leonids, &c., radiants pretty high | 80·7 | 55·7 | 42·3 | 41·0 | 36 | 5 |
| Very swift, with streaks, radiants low | 73·8 | 63·5 | 53·9 | 39·0 | 11 | 6 |
| Rather slow, high radiants | 67·1 | 47·4 | 27·2 | 19·3 | 47 | 7 |
| Slowish, low radiants | 60·2 | 51·3 | 35·5 | 17·4 | 15 | 8 |

The following conclusions have been drawn from a study of the results and from an examination of other materials of similar character which have been published by various observers and computers from time to time. Some of the statements have been made in previous papers by the writer, but in a detached and less definite manner.

The swift meteors are decidedly higher in the atmosphere than the slow meteors. The luminous flights of fireballs are much longer generally than those of ordinary shooting stars. Both fireballs and shooting stars from low radiants have longer paths than those from radiants at high altitudes.

Nearly all the slow-moving fireballs are directed from radiants in the vicinity of the horizon. The great majority of fireballs travel slowly, and their radiants are placed in the western half of the sky and somewhere in the region of the earth's anti-apex.* The most numerous class of shooting stars would appear to be formed by the swift meteors directed from radiants fairly elevated in the eastern sky, but this will not be found invariably true for all seasons, there being many strong showers clustered at distances rather remote from the apex of the earth's way and yielding an abundance of shooting stars which exhibit a medium or slow rate of velocity. Theoretically the swift meteors should greatly predominate were meteor streams generally distributed in an equable manner, but this is far from being the case, and the result is that moderately slow or slow meteors are often more plentiful than any other class. It is true that our lists of real paths contain a great excess of swift meteors, but it must be remembered that the bulk of the observations has been effected during the Lyrid, Perseid, Orionid, Leonid and Geminid epochs, when such meteors are exceedingly frequent, though most of them have their origin in the special systems referred to and do not prove a general prevalence of rapidly moving objects.

A singularly well-marked height at which slow-moving fireballs disappear is 26-29 miles. Comparatively few large or small meteors become extinct when between 31 and 42 miles above the earth. Nearly all the well-observed meteors have vanished either between elevations of 20-30 or 45-60 miles. Fireballs are more frequent within two hours or so after sunset than at any other time of the night; in fact the number of these bodies which make their apparitions in the evening twilight is quite remarkable. They are also often noticed in the morning not long before sunrise. This notable frequency cannot be explained on the supposition that more people being about at the hours stated than at other periods near the middle of the night there would naturally be more records of these objects. Regular meteoric observers do not witness many fireballs of the larger kind because such bodies commonly make their appearance at times either before or after the usual hours when meteor watches are conducted, and indeed they often present themselves when least expected and in conditions of sky not well suited for their observation.

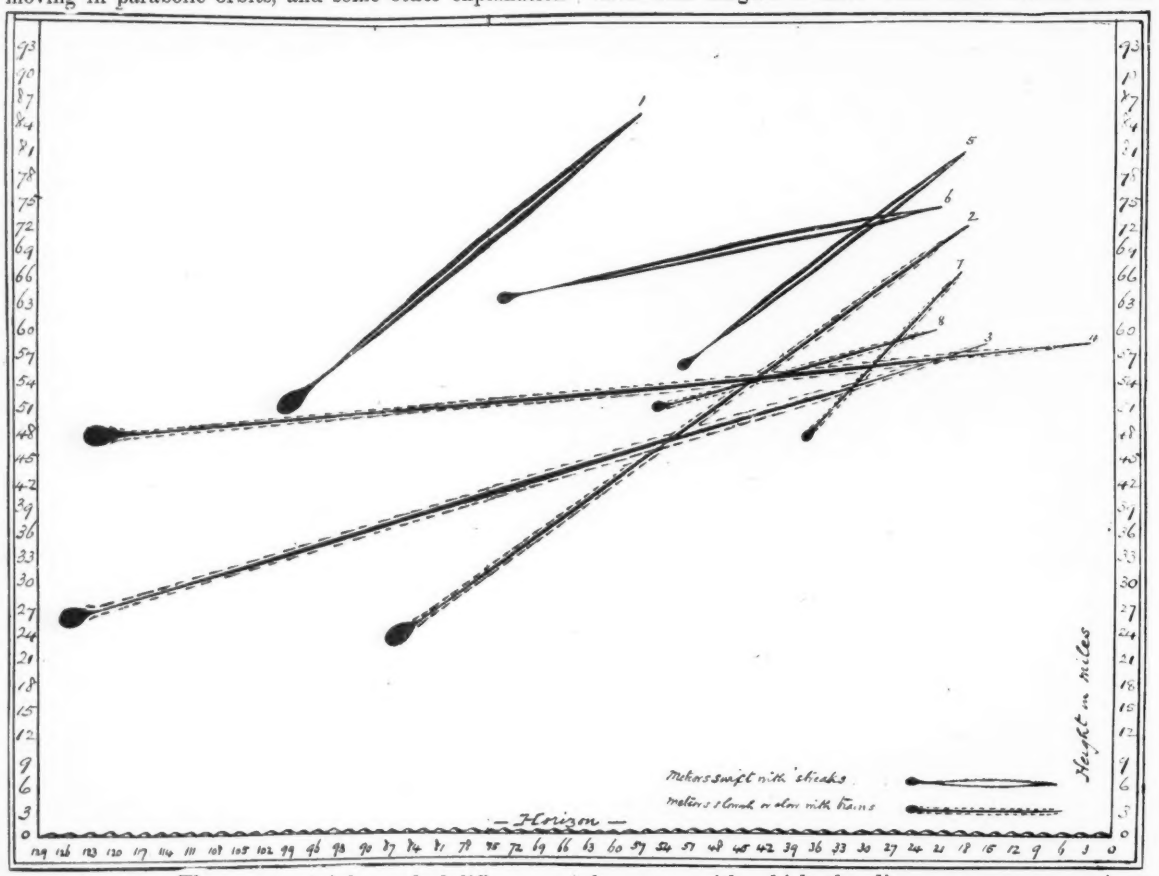
The zodiacal constellations are very rich in prominent fireball radiants. (*Monthly Notices*, Vol. LVII., p. 561.) For instance, there are well-defined showers from Pisces (Aug.-Sep.), Aries (Oct.-Nov.), Taurus (Nov.), Gemini (Dec.), Cancer (Jan.-Feb.), Leo (Feb.-Mar.), Libra (April), Scorpio (June-July), Sagittarius (June), Capricornus (July-Aug.), and Aquarius (July-Aug.). The slow-moving fireballs from radiants in the west would seem to be usually isolated and to be unaccompanied by any smaller meteors forming a definite shower-radiant. They

* *Monthly Notices*. Vol. LIV., p. 538.

overtake the earth in her orbit and move in direct orbits like the comets of short period.

The observed motion of certain fireballs and shooting stars is slower than that computed from parabolic velocity. Thus a meteor belonging to the May Aquarids seen on 1900, May 3, traversed a long and nearly horizontal flight of about 155 miles at a velocity of 28 miles per second, while the theoretical speed was 40 miles per second. Atmospheric resistance must undoubtedly induce a retardation in the velocity, and particularly in those cases where the objects penetrate to low altitudes and encounter the denser air strata. But the observed velocity has been occasionally found less than half that which would be shown by bodies moving in parabolic orbits, and some other explanation seems necessary. There are certainly marked differences, both in the apparent and real velocity of meteors from a common radiant. On 1901, Aug. 10, 10h. 58m., a very slow shooting star was observed at Slough, Farnborough, and Bristol, with a velocity of about 16 miles per second and a radiant at 352° — 14°.† On Aug. 18, 13h. 24m., a shooting star was seen at Slough and Bristol with a velocity of 15 miles per second and a radiant at 106° + 52°.† In these cases the rate of motion was carefully estimated, and the several values were very consistent with each other, but the speed only amounted to about half that which would have been exhibited by unchecked objects moving in parabolic orbits. Of about five meteors registered during the Perseid epoch from the Lyncid shower at 106° + 52°, four were of the swift, streak-leaving class, while the one mentioned above as apparently directed from the same radiant was "very slow" and offered a great distinction to the others.

The abnormally slow motion found in the two cases named cannot be wholly attributed to atmospheric resistance, for other meteors coming from the same radiants exhibited no signs of similar retardation. When comparing observations of fireballs and deducing their real heights I have been much struck at the




frequency with which the disappearance occurs at an elevation of about 27 or 28 miles. It is comparatively seldom, according to my experience, to meet with a really well-observed fireball or meteor which disappeared between heights of 31 and 42 miles. From the computations made here of 96 fireballs I get the following figures: —

| Height at disappearance. | Number of Fireballs. | Percentage. |
|---|---|---|
| Less than 12 miles ... | 1 ... | 1·0 |
| 12 to 21 miles ... | 19 ... | 19·8 |
| 22 to 31 „ ... | 30 ... | 31·3 |
| 32 to 41 „ ... | 12 ... | 12·5 |
| 42 to 51 „ ... | 19 ... | 19·8 |
| 52 to 61 „ ... | 9 ... | 9·4 |
| Exceeding 61 miles ... | 6 ... | 6·2 |

Combining this table with some similar and extensive

† The real paths of these objects were independently computed by Prof. Herschel at Slough, by Lieut.-Col. Tupman at Harrow, and by the writer at Bristol, and the resulting velocities were in excellent agreement. Lieut.-Col. Tupman has also determined the orbital elements, and finds a periodic time of only 224 days for the Aquarid of August 10, and of 327 days for the Lyncid of August 18, on the assumption that at the great height of 60 or 70 miles the atmospheric resistance is a negligeable quantity.

results obtained by Prof. A. S. Herschel and Dr. Von Niessl, including 166 additional fireballs, I get the following:—

| Height at disappearance. | Number of Fireballs. | Per-centage. |
|---|---|---|
| Less than 12 miles ... | 15 ... | 5·7 |
| 12 to 21 miles ... | 55 ... | 21·0 |
| 22 to 31 „ ... | 79 ... | 30·2 |
| 32 to 41 „ ... | 39 ... | 14·9 |
| 42 to 51 „ ... | 37 ... | 14·1 |
| 52 to 61 „ ... | 24 ... | 9·2 |
| Exceeding 61 miles ... | 13 ... | 5·0 |

Thus the independent values derived from the investigations of Prof. Herschel and Dr. Von Niessl generally corroborate those obtained at Bristol, though they do not indicate such an exceptional rarity in the disappearances between 31 and 42 miles.

Prof. Herschel's heights at disappearance seem pretty evenly distributed between 19 and 30 miles, while the same may be said of Dr. Von Niessl's from 18 to 28 miles.

With reference to the length of path, shooting stars do not often extend over 50 miles, though in rather exceptional cases, when the radiant closely borders the horizon, they may considerably exceed 100 miles; as, for example, the Aquarid of 1900, May 3, already referred to. But the luminous flights of the slow-moving fireballs are usually more than 100 miles in length, and such objects often furnish grand spectacles, remaining visible from about five to twelve seconds, exhibiting a very intermittent light, and flashing out brilliantly several times as they plough their way through the atmosphere. Dr. Von Niessl's mean length of path for many large meteors observed from the continent of Europe and America is much greater than that deduced from similar objects seen in England. Possibly the discordance may be in part explained by the fact that in this country the sphere of observation is so curtailed that the visible limits of very long-pathed meteors cannot be followed, there being no observers in the region nearly under the beginning or end points which must often be placed vertically over the sea. In other parts of Europe and in America, however, the vast expanse of country enables large meteors to be successively seen at distant stations underlying their lines of flight. Thus the fireball of 1868, Sep. 5, was computed by Dr. Von Niessl to have traversed a path of 1770 miles, from Servia to France.

It is seldom that either fireballs or shooting stars are first seen at heights exceeding 100 miles, and it appears questionable whether any have ever been observed at an elevation reaching 130 miles. Heis and Niessl give rather numerous instances where the computed heights have been over 130 miles, and I have also met with a few cases of abnormal elevation, but so far as recent investigations enable me to form a just opinion, I conclude that a meteor with any part of its real path at a height exceeding 100 miles must be regarded as a rarity. The very swift meteors begin their observed luminous careers at heights from about 90 to 75 miles, while the slow meteors commence at elevations ranging from 75 to 55 miles.

An observer, after long acquaintance with the details of these observations, and after much practice in the computation of the heights of meteors, the fall of many of which he has himself witnessed, can generally estimate the height, length of path and velocity of an object to within small limits of error, immediately after seeing it. He can often assign the radiant correctly, and, having carefully noted all the visible features of the object, he recognises it as belonging to a certain class and can thus form a very good idea as to its actual course in the air. If the meteor is an ordinary Perseid, observed at a time of night when the radiant of that shower is pretty elevated, he will be tolerably sure that the flight ranged from about 81 to 56 miles in height. If the object is a slow-moving fireball, leaving a train of yellow sparks, and directed towards the eastern sky from a westerly radiant not *very* near the horizon, he will be tolerably certain that it descended from a height of about 60 to 27 miles along a path of 100 miles or more.

But meteors sometimes display vagaries capable of putting the most experienced and best judgment in fault. In fact there is probably no branch of astronomy in which more blunders are possible and in which more are actually committed than in meteoric work. Be the observer ever so practised and his knowledge of the various radiants and of the details influencing their correct determination ever so complete, he cannot attribute any meteor to its centre with absolute certainty that it is correct. Even when the case is one in which he feels an unusual amount of confidence, he is liable to find afterwards should a duplicate observation come to hand, that he has been mistaken in his judgment. Possibly an old observer could correctly assign the radiant in three cases out of four, but it is always a difficult performance, and requires not only that the direction of flight should be very accurately observed, but that all the visible features of each meteor should be attentively noted, as they often serve to indicate the pretty exact place of the radiant when the path alone leaves it open to doubt.

## CONSTELLATION STUDIES.

By E. WALTER MAUNDER, F.R.A.S.

### XI.—THE RAM AND THE BULL.

CLOSE beneath the lower points of the greater W, noticed in our last constellation-study, that is to say, close beneath Beta Persei and Beta Trianguli, is the small but distinguished constellation of the Ram. He can also be found readily by following the stars which mark the belt of Andromeda. Proceeding from Nu Andromedæ through Mu and Beta, we find at double the distance between Nu and Beta, the extremely flat triangle which marks the Ram's head. As Aratus tells us:—

> "No splendid gems his golden fleece adorn,
> Two dimly glitter on his crooked horn.
> If you would find him in the crowded skies,
> Beneath Andromeda's bright belt he lies."

Of these three stars, the brightest, Alpha, is the furthest to the north and east; Beta, the next in brightness is next also in position; and Gamma the most southern and westerly, is the faintest. A compact little triangle about half-way from Alpha Trianguli to the Pleiades comprises practically all the other important stars of the constellation.

The mythology of the constellation is as little striking as is its actual appearance in the sky. It is, of course, associated in Greek mythology with the voyage of the Argo; it is indeed the Ram whose golden fleece the Argonauts went forth to seek. But the story carries no conviction with it, nor is there anything in the surrounding constellations to support the legend, although so great an astronomer as Sir Isaac Newton held that the stellar symbols were intended simply as a record of the Argonautic expedition.

An explanation which at first sight appears more plausible, asserts that the Ram was the constellation

in which the sun was placed at the spring equinox at the time when the constellations were mapped out, and that as the first of the zodiacal twelve, it was natural to symbolize it as the bell-wether of the starry flocks. Unfortunately for this theory we know that the constellations were mapped out at a far earlier epoch when the equinox fell in the middle of the constellation Taurus.* At that date the constellation of the Ram came last of the zodiacal twelve, and to represent it as the stellar bell-wether would have been absolutely the most unnatural thought possible.

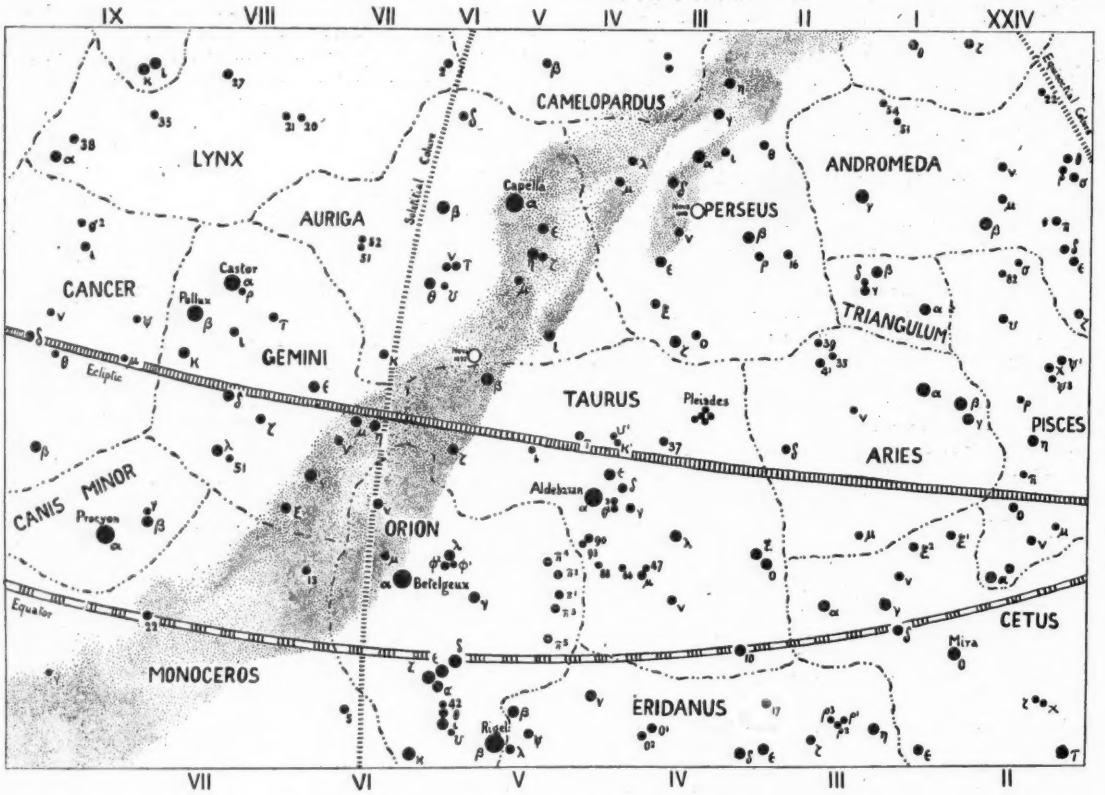
Yet from an early age it has had that position. It is the leading sign in the systems of astrology which have come down to us through the Greeks, and it figures as the leading sign in most of the explanations of the constellation figures which have come down to us from antiquity.

There is a great significance in this fact. It proves at once that these astrological systems and these theories of the constellation figures, not only took their rise at a later epoch, but that when they took their rise the real origin and meaning of the designs had been wholly lost.

The only stars in the constellation that are usually known by their Arabic names, are the three in the head. Alpha is known as Hamal, the "Ram," the brightest star being put for the entire constellation. Brown indeed asserts that the stellar Ram was in the first place only the star Hamal, the constellation being formed round it afterwards. In Chaucer the star is referred to as Alnath, that is to say, "the horn-push," a name more commonly associated nowadays with the star on the tip of the northern horn of the Bull, Beta Tauri, to which it is even more appropriate.

> "And by his eighte speres in his working,
> He knew full well how far Alnath was shove
> Fro the head of thilke fix Aries above,
> That in the ninthe spere considered is."

Since the actual stars were accounted to be placed in the eighth sphere whilst the twelve equal signs of the zodiac, each of thirty degrees of longitude, were placed in the ninth, Chaucer is here stating that his astrologer knew the distance from the first point of Aries, that is to say from celestial longitude 0°, to the first star in the actual constellation Aries. In other words, he knew the amount of precession.



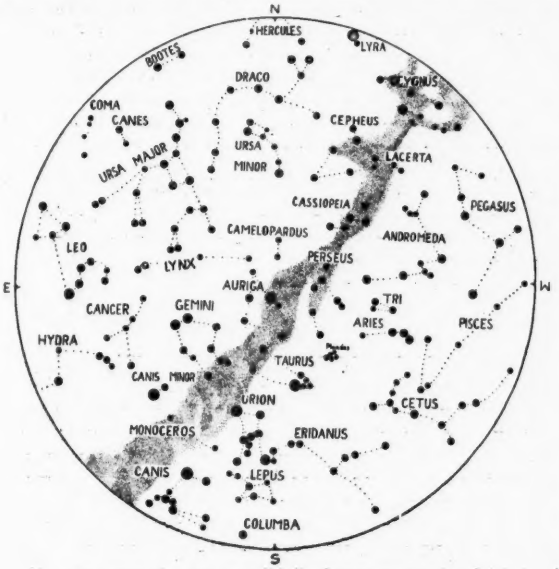

Star Map No. 11; The Region of the Ram and the Bull.

Beta and Gamma bear the names Sheratan and Mesartin, the former word meaning "the two signs," the latter "the two attendants," the two names taken together therefore meaning "the two attendant signs," these two stars being considered as attendants on Hamal.

A far brighter as well as larger constellation is that of the Bull, the original leader of the zodiacal twelve. There is no difficulty at all in finding its principal stars. The Pleiades, to the naked eye by far the most striking star cluster in the heavens, mark the shoulder of the Bull; the Hyades, a looser, but yet brighter group, mark its head. The latter group forms an exceedingly well-marked capital V. Aldebaran, Alpha Tauri, a bright

* Through an obvious slip, Mr. R. Brown, on page 54 of Vol. I. of "Primitive Constellations," is made to say that the stellar Ram "onwards from B.C. 2540 opened the year," instead of "from 2540 *years ago*," the time when the equinox really fell amongst the three stars of the Ram's head.

orange star, marks the upper left hand of the V, Epsilon Tauri similarly marks the point on the right, whilst Gamma marks the angle. Theta 1 and Theta 2 lie between Alpha and Gamma, and three stars marked Delta lie between Gamma and Epsilon. Following the two branches of the V eastward to about four times their length, we come to Beta and Zeta, which mark the tips of the two horns, Beta, the northern horn, being much the brighter of the two. These are the chief stars in the constellation, for the Bull, like Pegasus, is shown only in half length, and beside his




The Midnight Sky for London, 1901, December 3.

head and horns possesses little but the fore-legs. Iota Tauri stands just mid-way between Beta and Zeta on the one side, and Alpha and Epsilon on the other. A straight line from Iota through Gamma leads to Lambda Tauri, and followed on, passes just below Omicron Tauri, which forms a pair with Xi Tauri.

The names in the constellation in familiar use to-day are restricted to the names for the two groups, the Pleiades and the Hyades, to the classical names for the individual stars in the former group, and to the two stars Alpha and Beta. Beta, as already noted, is Alnath, "the horn-push"; Alpha is Aldebaran, "the follower," that is to say, of the Pleiades.

"Near Perseus' knee, the Pleiads next are rolled
Like seven pure brilliants set in ring of gold;
Though each one small, their splendour all combine
To form one gem, and gloriously they shine.
Their number seven, though some men fondly say
And poets feign that one has passed away.
Alcyone—Celœno—Merope—
Electra—Taygeta—and Sterope—
With Maia,—honoured sisterhood—by Jove
To rule the seasons placed in heaven above.
Men mark them rising with the solar ray
The harbinger of summer's brighter day.
Men mark them rising with Sol's setting light
Forerunners of the winter's gloomy night.
They guide the ploughman to the mellow land;
The sower casts his seed at their command."

Of all the star groups none figures so largely in myth and legend and literature as the Pleiades. The name Pleiades is probably derived from the Greek Pleiones, "many," and accords with the Hebrew Kimah, "the cluster"; the Babylonian "Kimtu," "the family," and the Arabic Ath-thurayya, "the little ones." The names given to the individual stars are those of the seven daughters of Atlas and Pleione. According to Aeschylus they were placed in heaven on account of their filial sorrow when their father was turned into the mountain and laden with the weight of the firmament. Of the numerous other names which have been given them, the "Hen and Chickens" is one of the most familiar. Thus Miles Coverdale in a marginal note to the book of Job in his translation of the Bible, calls them "the Clock Henne with her chickens." Many of the Greek poets refer to them as "the doves" or "rock pigeons," writing their name as "Peleiades." They were likewise the "Vergiliae," "the stars of spring," or the "Atlantides," from their father. Modern astronomers have commemorated Atlas and Pleione, the parents of the seven, in the pair of stars on the east of the group.

Their value to the ancients as an indication of the seasons and the progress of the year was immense. As noted in Dr. Lamb's unduly expanded paraphrase from Aratus quoted above, their heliacal rising showed the commencement of summer, their acronical rising the commencement of winter. Four thousand years ago they marked the position of the sun at the spring equinox, and were therefore then especially closely connected with the revival of the forces of nature in the opening year. This no doubt is the first meaning of the reference to "the sweet influence of the Pleiades" in Job xxxviii. Whilst in conjunction with the sun they were hidden from view for forty days, reappearing as summer drew near. Thus Hesiod sings:—

"There is a time when forty days they lie
And forty nights concealed from human eye;
But in the course of the revolving year
When the swain sharps the scythe, again appear."

In November, on the other hand, they are up all night and are on the meridian at midnight. In some mysterious way they became associated with the memorial observances for the dead which in so many nations have always been associated with this month of November, and which seem to point to the great Christian commemoration of All Saints' Day.

A keen sight will count nine or ten stars in the group. Moestlin, according to his pupil Kepler, counted fourteen. Miss Christabel Airy plotted twelve; but these high numbers are hardly obtained legitimately, inasmuch as they include stars lying at some considerable distance from the main portion of the group. Six stars are easily seen, and amongst nations the most widely scattered and unconnected, we find the tradition that though six stars are only visible to-day, seven was their original number. The probability seems that this is no mere legend, but the record of an astronomical fact. Several of the present Pleiads are slightly variable, and Alcyone, the leader in brightness to-day, would seem to have only attained that rank within the last few centuries. It is therefore quite conceivable that one of the members of the group, now too faint to be detected without a telescope, may in time past have fully rivalled her sisters.

Even such small magnifying power as an opera-glass can lend greatly increases the beauty and interest of both the Pleiades and the Hyades, and the whole region between the Bull's horns. Close to Zeta Tauri, the southern horn tip, is the Crab nebula, the first in Messier's catalogue, and, from its comet-like appearance, a snare to beginners in the art of comet seeking. Zeta Tauri marks very nearly the radiant point of a shower of very slow and bright meteors, active at the end of

November and early in December; whilst Epsilon Tauri is not far from the radiant point of the other great Taurid stream, active from October 20 to the end of November.

Lambda Tauri is a variable star of the same class as Algol, Beta Persei; that is to say, its variation is due to the transit across it of a dark companion. Its period is 1h. 12m. short of four days; its maximum, or rather ordinary light, ranks it of magnitude 3.4, at minimum it sinks down to 4.2.

"Next the broad back and sinewy limbs appear
Of famed Auriga, dauntless charioteer,
Far in the north his giant form begins
Reaching athwart the sky the distant Twins,
The sacred goat upon his shoulder rests,
To infant Jove she gave a mother's breasts.
Kind foster nurse! Grateful he placed her here,
And bade her kids their mother's honour share.
* * * * * * *
Auriga and the Bull together meet,
Touches his star-tipped horn the hero's feet.
The Bull before him to the west descends
Together with him from the east ascends."

Beta Tauri, the northern horn, belongs also traditionally to the constellation of Auriga; now known as "the charioteer," although no chariot is visible, and in Ptolemy's star list as well as in our modern representations he is described as in the attitude of a shepherd, carrying a goat on his shoulder and a pair of little kids in his hand. The Greek name for the constellation is Heniochus, "the holder of the reins"; a name preserved for us in the Arabic name for Beta Aurigae, "Menkalinan," "the shoulder of the rein-holder."

The chief stars of the constellation are easily picked out. Capella, a bright star of a yellowish creamy light, nearly balances the steel-blue gem Vega on the opposite side of the pole star. Close to Capella, three small stars in a long right-angled triangle, form an unmistakable mark of identification to it. Glancing back to Sirius, Procyon, Castor and Pollux, we find that they form a magnificent curve, which, carried onwards, passes through Beta Aurigae, and ends in Capella. Taking Beta as the head star of a cross, Capella marks the western extremity of the crossbeam, Theta the eastern, and Iota the foot. A straight line from Theta upwards through Beta leads to Delta, a star which marks the head of the figure. Of the three stars marking the little triangle by Capella, Epsilon is the nearest to Capella, and Eta and Theta, known as the Haedi, "the kids," mark the short side of the triangle.

In recent years the constellation has been most distinguished by the appearance of the new star discovered on February 1, 1892, by Dr. T. D. Anderson, using only a small pocket telescope. The position of the Nova is in the extreme south of the constellation, about 3° to the north of Beta Tauri. At the time of discovery it was about the 5th magnitude, and slightly brighter than Chi Aurigae, which is just 2° to the north of it.

## Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

### BRILLIANT METEOR IN CALIFORNIA.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—On August 17th, at 7.55, a very brilliant meteor passed over this district and was observed by a great many people. It was seen all along the Pacific coast from San Diego to Los Angeles, and from places thirty or forty miles east of the coast. Unfortunately I only saw the flash, through the open doorway, every tree and the houses, etc., were most brilliantly lighted up, as if a most powerful searchlight had been swung across them. I have received a great many descriptions of the meteor from eye witnesses, some of them very conflicting, as nearly everyone saw it burst in a different place; some heard the report of the explosion and felt the earth tremble, while others heard no noise, but all agreed in describing it as very large and leaving a brilliant train. From all the evidence I think the following is the best and most accurate:—The direction was from the zenith to a point a little east of Polaris, the head was very large, perhaps half the diameter of the moon, and pear shaped; there were numerous explosions along its path, leaving many brilliant fragments, and a final explosion when it disappeared, which was distinctly heard by several people on the mountains, who said the earth trembled as it would with a slight earthquake.

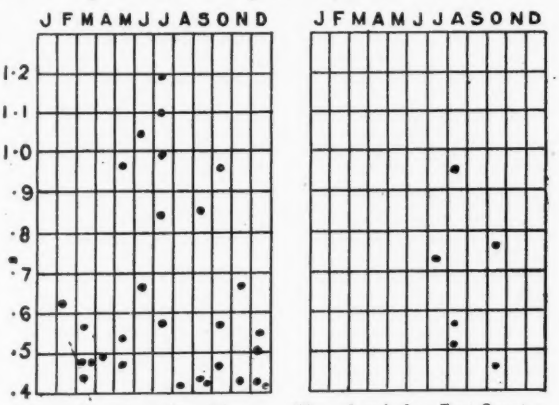
I observed nineteen of the Perseid meteors on August 11th between 8 and 10, high fog prevented observation on the other evenings. S. D. PROCTOR.

Encinitas, California, U.S.A.
Sept. 3rd, 1901.

### DOES THE MOON AFFECT RAINFALL?

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Recent Greenwich records apparently point to a maximum of wetness about the time of new moon, and a minimum shortly before last quarter. To appreciate the nature of this contrast, let us take the last twelve years (1889-1900), and confining our attention to the three days about new moon, on the one hand, and three days before last quarter on the other, ask how often, in these three-day groups, there occurred a rainfall of ·4 in. or more in one day, and how these cases were distributed. The answer is supplied by the rough diagram herewith, in which each dot represents a wet day of the magnitude indicated. There are 29 cases in the three days about new moon, and only 6 in the three days before last quarter (about one-fifth of the other). While these wet days have occurred in every month but January in the one case, they are confined in the other to the three months—July, August, and October. It may be interesting to observe whether such a contrast is maintained in future. At present I have not the opportunity of extending the above inquiry beyond the last twelve years, but perhaps some of your readers may be inclined to do so.




Three days about New Moon. Three days before Last Quarter.

ALEX. B. MACDOWALL.

# NOTES.

ASTRONOMICAL.—Prof. Campbell has recently published further details of the system of Capella, which was recognised as a spectroscopic binary by Mr. Newall and himself independently. (Lick Obs. Bull., No. 6.) The principal star has a spectrum of the solar type, and its velocity ranges from +4.2 to +55.7 km. per second, while the companion has a spectrum between the solar and Sirian types and a velocity in the line of sight ranging from —3 to +63 km. per second. The masses of the two components are therefore as 1.26 to 1, but for various reasons, the masses in terms of the sun are as yet indeterminate. The orbit is nearly circular, the period 104 days, and the whole system is receding from the sun at the rate of 25·76 kilometres per second. As the inclination of the orbit cannot be determined with the spectroscope, the actual size of the system remains unknown, but with the smallest permissible orbit, the two stars will be 85,000,000 kilometres apart when most distant from each other. So far, even under the most favourable conditions, the Lick telescope has failed to show any indications of the binary character of the star. The latest investigations of the spectroscopic binary $\eta$ Pegasi indicate for this star a period of 818 days (Bulletin No. 5).

As was to be expected, a very valuable set of observations of Nova Persei has been secured at the Lick Observatory (Bulletin No. 8). The position of the star has been carefully determined by meridian observations and by micrometric measures, and a long series of estimates of magnitude have been recorded. Extensive spectroscopic observations have also been made, and the high dispersion employed has revealed much minute detail which may perhaps turn out to be of great importance. Among the more important results, it appears to have been established that the velocity of the Nova, as indicated by the fine dark line superposed upon bright H has been practically constant and very small, up to September. At present the spectrum is nebular, an additional demonstration of this being furnished by the discovery that the Nova line near $H_\epsilon$ occurs as a line at $\lambda$3967·6 in N.G.C. 7027, and that the strong ultra-violet line about $\lambda$364 also appears in some of the well-known nebulæ. It is the last named radiation which probably causes the spurious aureole surrounding the photographic image of the Nova as depicted by a refractor.

From the Lick Observatory comes the startling announcement that four nuclei in the true nebula in which Nova Persei is involved have been displaced by a minute of arc in six weeks.

One of the most remarkable stars in the heavens is $\eta$ Argûs, which between 1677 and 1870 fluctuated between magnitude 0 and 6·8 and has since faded to $7\frac{3}{4}$. It has long been known that the spectrum was an uncommon one, and recent photographs taken by Sir David Gill show that it is full of bright lines which are apparently similar to those of Nova Aurigæ and Nova Persei in their earlier stages. Dr. F. McClean has already drawn attention to the fact that the spectrum is practically a reversal of the pectrum of $\alpha$ Cygni.—A. F.

BOTANICAL.—The well-known fairy rings met with on our lawns and pastures are produced by various species of Fungi, most frequently by *Marasmius oreades*. In North America it has been observed that similar peculiarities of growth are affected by other plants besides Fungi. In *Rhodora* Dr. Robinson cites the case of one of the club mosses, *Lycopodium inundatum*. He attributes the rings to the plants moving outwards from the centre in search of fresh soil and new food supplies. Mr. W. N. Clute in the October number of the *Fern Bulletin* records instances of rings formed by species of *Osmunda*, and conjectures that these rings have taken at least a hundred years in their formation. *Monarda didyma*, a Labiate often seen in British gardens, is also, according to Professor Beal, a producer of fairy rings.

The origin of the eminently useful cocoanut palm, like that of several other valuable economic plants which have been in cultivation for very long periods, is still disputable. De Candolle, in his *Origin of cultivated plants*, expressed the opinion that, though he formerly thought that the arguments in favour of Western America were the strongest, a more extended study of the subject inclined him to the idea of its origin being in the Indian Archipelago, a view which received the support of many celebrated naturalists. Mr. O. F. Cook has been dealing with the question in the recently issued number of the *Contributions from the U.S. National Herbarium*, and arrives at the conclusion that the original habitat of the palm is to be sought in South America, the probabilities favouring the alkaline regions of the Colombian Andes. It is pointed out as a forcible argument that all the other known species of *Cocos* are natives of South America, and no other genus of palms is common to America and Asia or Polynesia.—S. A. S.

ENTOMOLOGICAL.—Both on account of the interest of their habits and of their importance from an economic standpoint, the gall-midges (*Cecidomyiidæ*) are worthy of more attention than they usually receive from naturalists. Their small size makes their study very difficult. Specially acceptable therefore is the recent issue of the Abbé J. J. Kieffer's "Monographie des Cécidomyides d'Europe et d'Algérie," in the *Ann. Ent. Soc. France*, Vol. LXIX., 1900, pp. 181-472, pls. 15-44. This work includes a very full bibliography, a detailed account of the anatomy of the midges and their larvæ, a summary of the very various ways in which the latter feed in different plant tissues, each causing its characteristic gall, and a systematic account of the genera into which the family has been divided. The species of economic importance—the dreaded "Hessian-fly" of wheat and the "Pear-Midge" are well-known examples—are dealt upon at length, and the natural and artificial means of checking their ravages are pointed out. Among our helpers in the destruction of these injurious insects are to be reckoned birds, spiders, insects (chiefly parasitic Hymenoptera), and minute thread-worms, which live inside the Cecidomyids in both larval and perfect stages.

From notices in the various entomological journals, the year 1901 seems to have been remarkable for the great abundance of Hawk-moths in the British Isles. Records of the "Death's-head" (*Acherontia atropos*) and of the Convolvulus Hawk-moth (*Protoparce convolvuli*) have been plentiful, and the latter insect seems to have bred freely with us, as caterpillars have occurred in Scotland and Ireland, as well as in England. The green form of the caterpillar—a marked contrast to the brown type—has been noted in several localities.

The scales on the wings of butterflies and moths are often considered to be purely of ornamental importance. In a recent paper "Ueber Nervenendigungen auf dem Schmetterlingsflügel" (*Zoolog. Jahrb. Abth. f. Anat.*, XIV., 1901, pp. 551-572, pl. 42), Dr. K. Günther points out that they must have to some extent a sensory function, as their roots are sometimes in contact with processes emanating from special cells of the hypodermis into which fine nerve-endings pass.—G. H. C.

ZOOLOGICAL.—In the *Geological Magazine* for October Mr. C. W. Andrews continues his preliminary description of the wonderful new Eocene vertebrate fauna recently brought to light in the Fayum district of Egypt; this part being chiefly devoted to the reptiles. Perhaps the most remarkable of these is a large fresh-water tortoise belonging to the "pleurodiran" division, or those in which the head and neck are moved sideways; this group being now restricted to the southern hemisphere, although it was formerly spread over much of Europe and Asia. The most remarkable feature about the new form (for which the name *Stereogenys cromeri* is proposed) is connected with the palate, which has a structure recalling that of modern crocodiles, the palatal aperture of the nostrils being placed quite far back. The collection is also noteworthy on account of containing remains of the largest snake hitherto known, which the author calls *Gigantophis garstini*. If the vertebræ of this monster bear the same proportion to its length as obtains in the case of modern pythons (to which it is allied), it could not have been much, if at all, short of thirty feet. Another new generic type of serpent (*Mæriophis schweinfurthi*) appears more nearly relative to *Palæophis* of the European Eocene. We await with interest the author's opinion as to the bearing of the new discovery on current views as to the past distribution and migration of animal life in Africa.

Those of our readers interested in cephalopods will remember that years ago Professor Owen described the "animal" of the nautilus, on the evidence of a single specimen, then regarded as a great rarity. For centuries, however, it appears probable that the fishermen of certain small islands in the Philippines have been constantly in the habit of taking nautiluses, which enter their fish-traps at certain seasons of the year in considerable numbers. Hearing of this, Mr. Bashford Dean recently made a trip to Negros Island, where he was successful in obtaining several specimens; and he would have got more had his visit been timed at the right season. The traps are sunk in deep water, and the nautiluses enter with the fish. "The shells," writes Mr. Dean in the *American Naturalist* for October, "have hitherto found little market; locally, they are used as drinking cups or flower vases, and are sometimes cut into roughly-shaped spoons. But they are now bought extensively by Chinese shopkeepers, and at such good prices that there will probably be a goodly nautilus fishery before long. The Chinese, I was told, export the shells to China, where they are used as material for button-making." British mother-of-pearl dealers and manufacturers ought to bestir themselves and see whether nautilus-shell is not suitable for their own purposes.

The Entomological Division of the U.S. Department of Agriculture is displaying even more than its usual vigour in describing insect pests and the remedies best calculated to stay their ravages. Three bulletins have recently been issued by the division, one dealing with the "fall army-worm" and variegated cut-worm, another describing a new beetle whose attacks are ruining the forests of red spruce in New England, and a third treating of various pests.

"Luck" sometimes attends the efforts of naturalists. Years ago the secretary of the Zoological Society described what he regarded as a new species of rhinoceros from Chittagong, chiefly upon its hairy character. Upon the death of the specimen Mr. O. Thomas decided that these characters were of no value; but that, on account of its superior size, the Chittagong rhinoceros was still entitled to distinction from the Sumatran animal, although only as a sub-species.

The addition of a new genus of living mammals to the fauna of Europe or its confines is an event of sufficient interest to be recorded in this column. The creature in question is a vole from the Caucasus, for which the name *Prometheomys schaposchnikowi* is proposed by its describer, Dr. C. Satunin, in the *Zoologische Anzeiger* for September. It is described as being of the size of a small water-vole, and chestnut-brown in colour, with lighter feet; the minute eyes are covered with skin. The teeth are nearest to those of the mole-voles, or zokors (*Ellobius*). The single example was taken under flowering anemones.

The full text of Dr. W. T. Blanford's important memoir on the distribution of vertebrate animals in India, Ceylon, and Burma, has just been published in the Philosophical Transactions of the Royal Society, illustrated by a coloured map. The leading features of Dr. Blanford's division of India into zoological provinces have been already mentioned in these columns.

## Notices of Books.

"USE-INHERITANCE; ILLUSTRATED BY THE DIRECTION OF HAIR ON THE BODIES OF ANIMALS." By Walter Kidd, M.D. (A. & C. Black.) Illustrated. 2s. 6d. net.—The interest of this able little work is two-fold. In the first place the author describes and classifies the remarkable "whorls" occurring in the coat of so many mammals (especially the hoofed group), which form the starting points of changes in the direction of the hair. The second and most important object of the book is, however, to show that changes in the direction of the hair-slope of animals have been acquired by use and become inherited; a very notable instance of this being the direction of the hair-slope on the backs of a certain percentage of individuals of the human species. It is accordingly urged that, in this particular instance at any rate, the doctrine that acquired characters are never inherited does not hold good, and hence a Lamarckian explanation of the phenomena must be accepted. The case, as argued by Dr. Kidd, appears to be a strong one, and it will be curious to note what the out-and-out Weismannists will have to say in reply.

"A TEXT-BOOK OF ASTRONOMY." By Prof. G. C. Comstock. (New York and London: D. Appleton & Co. London: Hirschfeld Bros.) 7s. 6d. net.—This volume is well worthy of a place among the "Twentieth Century Text Books," and is a welcome indication of the increasing recognition of the value of astronomy as an educational subject. Personal observations, even with the simplest of home-made apparatus, are strongly recommended, and throughout the book the student is required to do many things besides merely reading the text. In those branches of the subject which do not provide suitable practical exercises, the author has given brief but clear and well balanced accounts which can hardly fail to attract the beginner, and lead him to search for more in works of a less general character. The numerous illustrations are well chosen and admirably reproduced, and they will well repay the careful study which is advised by the author; fig. 53 very clearly represents the moon's path with respect to the sun, and the variation in the number and latitudes of sun spots is illustrated in a very striking manner in fig. 82. We confidently recommend the book

to those who may require a sound introductory work on astronomy, and we think also that those who may be already familiar with the subject will find the author's methods of considerable interest.

"IRISH TOPOGRAPHICAL BOTANY." By Robert Lloyd Praeger. (Dublin Academy House.) With 6 maps. 10s. 6d.—The appearance of such works as the second edition of "Cybele Hibernica" and the volume before us within a period of four years implies considerable recent activity on the part of Irish botanists. This is confirmed by a perusal of the long list of papers which have been used by the author in the compilation of this volume, a large proportion of which have appeared during the last decade. From the point of view of plant-distribution, Ireland, by reason of its geographical position, geological structure and climatal conditions presents peculiar features of interest. It had, moreover, fallen somewhat behind the sister island in the study of its topographical botany, and the present advance was, therefore, highly desirable. The author, already well known by his numerous contributions to Irish botanical literature, has done yeoman service in bringing together the results of his own observations and those of other workers, in a form which will be of immense value to local botanists as well as to those who require materials for a study of plant-distribution on a larger scale.

For the purposes of this work Ireland is partitioned into 40 botanical divisions, corresponding for the most part with the counties, the six largest of which are further divided into 14 parts. The boundaries of the divisions, chosen with a view to their easy recognition in the field, are, therefore, not as a rule natural, and the scientific significance of the records is in consequence somewhat disguised. On the other hand, the areas are thus made comparable in size with those adopted by Watson for Great Britain, which is a point of some importance. The author makes a new departure from the established custom of similar works in the use of the latest records of localities in preference to those of the first discoverers. This, we think, is entirely commendable, as the object of the work is to give an account of the present-day condition of the flora rather than to perpetuate the memories of pioneers. At the same time, by comparing the late with the earlier records it would have been possible to draw up a list of plants which in the course of climatal, cultural, and other changes, have disappeared from certain localities. Such a list would be of considerable interest, and we have sought for it in vain.

The introduction is well written and contains much interesting information. A general explanation of the significance of the different types, signs, contractions, and punctuation used in the body of the work is to be found on pages xcii.-xcix. Although these are generally uniform with those used in other works of the kind, and are therefore familiar to botanists, we think, nevertheless, that it would have been an advantage if these explanations were given in the preface or in some equally conspicuous position where they would be more easily found.

The topographical botany of Ireland, as is shown on plate 4, is still by no means thoroughly worked out. Those who carry on the research will find their labours much lightened by this gathering together of all the information at present available. The author is to be sincerely congratulated upon the production of a work which has involved no small amount of labour and personal sacrifice, and the appearance of which will be hailed with satisfaction by all interested in Irish botany.

"DRAGONS OF THE AIR; AN ACCOUNT OF EXTINCT FLYING REPTILES." By H. G. Seeley. (Methuen.) Illustrated. 6s.—Partly, no doubt, owing to the account of their bony structure given in Dean Buckland's well-known "Bridgewater Treatise," Pterodactyles, in common with Ichthyosaurs and Plesiosaurs, are more familiar, at least by name, to non-scientific readers than are many other groups of extinct creatures. And this circumstance, together with the remarkable organisation of these reptiles, may be taken to justify the devotion of a work written on somewhat popular lines to their description and history. By no one have the "Flying Dragons" (as they ought to be called, were not the name usurped by an existing lizard) been studied with more care and attention than by Professor Seeley, who has devoted some of the best years of his life to the investigation of their structure and relationships. In this respect the author is probably better qualified than anybody else to tell the public all that is known concerning these strange reptiles. But there is such a thing as an *embarras des richesses*, and the learned professor's store of information with regard to pterodactyles is so great, while his views as to their affinities are so complex, that he has found it difficult to express himself with that simplicity so desirable in all popular works, and it is consequently a matter of some difficulty to ascertain the real nature of his views and opinions.

Unlike both birds and bats, pterodactyles flew by means of a membrane supported by the enormously elongated bones of the "little finger." And this essential difference in structure has induced the belief among the great majority of anatomists that, in spite of numerous resemblances, there is no near affinity between these reptiles and birds. This, however, is by no means the opinion of the author of the volume before us, who insists that there is some intimate relationship between the two; although the precise nature of this is left in great obscurity. Neither are the restorations of the bodily form of the "Dragons of the Air" commonly seen in palæontological works accepted by the author, who in this respect has struck out a line entirely his own, with the result that the creatures, as depicted by his artist, offer excellent examples of the "scientific use of the imagination." Whether they were capable of moving about in this posture is a question of which we may be permitted to have our doubts.

With every inclination to regard originality of view as of high value, we must confess to a feeling of disappointment with this work—if only for the reason that we cannot understand a large portion.

"ZOOLOGY. AN ELEMENTARY TEXT-BOOK." (Cambridge Natural Science Manuals.) By A. E. Shipley and E. W. MacBride. (Cambridge University Press.) Illustrated. 10s. 6d. net.—If we may judge by the number of manuals and text-books in course of issue for their benefit, the number of students of zoology must be increasing by "leaps and bounds"—otherwise it would apparently be a bad look-out for the publishers. We have, for instance, now in course of issue the "Cambridge Natural History" (a volume of which was noticed in our last issue), Professor Ray Lankester's "Treatise on Zoology," and the present series—all admirable in their way.

Unlike the "Cambridge Natural History," in which the two are treated together, the present series devotes separate volumes to extinct as distinguished from living types; the fossil vertebrates having been already described in a companion volume by Mr. A. Smith Woodward. In our own opinion the former method is decidedly preferable; but this is merely a matter of opinion, and on the lines which the editor has thought fit to adopt the present volume is in the main excellent.

Even with a dual authorship, it is no light task to write an up-to-date manual of zoology within the compass of an ordinary octavo volume, and the authors of the one before us are to be congratulated on the general success of their efforts.

As stated in the preface, the treatment is by no means equal throughout, the lower types, which come first in the volume, being described in a more elementary manner than those which follow. The reason of this is obvious. The reader is presumed to have no previous acquaintance with zoology, and he is accordingly introduced to his subject absolutely *de novo*. When he has proceeded some way in the book he is supposed to have assimilated the information contained in the earlier chapters, and his instruction accordingly proceeds by comparison with what he has learnt.

Great prominence is given to the doctrine of the "cœlom"; the majority of animal groups being classified as Cœlomata or otherwise. We must, however, find fault with the arrangement of the table of contents, in which no clue is given to the fact that the last four "phyla" do not belong to the Cœlomata. In respect of these last four groups the classification is a novelty so far as English text-books are concerned. Apart from the Protozoa, Cœlenterata, and Porifera, which come first in the series, the authors trace a gradual ascent from the worms to man; all these forms exhibiting more or less clearly, in one stage or other, the presence of the cœlom. When, however, the flat-worms (Platyhelminthes) are reached, the authors state that they come to four groups in which the presence of the cœlom cannot be definitely determined; and we accordingly find the Platyhelminthes, Nemertinea, Rotifera, and Nematoda placed, so to speak, above man. Although the arrangement appears peculiar, we are by no means prepared to say that it may not be defensible.

Having said that it is difficult for even two authors to write a comprehensive zoological treatise, we do not intend to presume that a single reviewer can criticize the whole. Our few critical remarks will, therefore, apply to one section. As regards birds, we notice that the authors refuse to regard the Tinamous as Ratitæ. In the paragraphs on Marsupial Mammals we think the work is scarcely up-to-date as regards the dentition and the origin of the group from an arboreal type. And there are many points of detail in regard to the treatment of the mammalia generally which afford opportunity for criticism. For instance, the statement that the ancestors of the Llamas originated in the Old World is opposed to American palæontological evidence; while a visit to the Natural Museum would serve to show that the statement as to the Giraffe being "confined to the grassy plains of the interior of Africa" is scarcely consonant with the real facts. Exception might also be taken to the statement that

XUM

a *mastodon* is a *large* elephant, and still more so that its teeth are always tuberculate instead of ridged. Moreover, like many morphological writers, the authors are not sound on the subject of nomenclature, otherwise they would not retain, albeit in a half-hearted kind of way, the title *Hyrax* for the dassies.

These and other blemishes of a like nature, although unfortunate, do not, however, in any way detract from the value of the work, which may shortly be described as excellently adapted to supply the needs of the class of readers for whom it is intended.

"A TREATISE ON ZOOLOGY; PART IV. THE PLATYHELMIA, MESOZOA, AND NEMERTINI." By W. B. Benham. (A. & C. Black.) Illustrated. 15s. net.—Contrasted with the work just noticed, the volume before us presents a striking instance of the diversity of view still prevalent among zoologists on many points. In the first place the name Platyhelmia is adopted instead of Platyhelminthes for the Flat-worms, and both this group and the Nemertines are definitely included in the Cœlomata (or Cœlomocœla, as the editor prefers to call this large assemblage), whereas, as we have seen, the authors of the foregoing work state that there is no justification for such inclusion. Nor does the want of agreement stop here, the Rotifera in the present work being far removed from the neighbourhood of the Flat-worms and Nemertines. As it is not our purpose to discuss which of the two views has the greater probability of right on its side, it will suffice to call attention to the existence of such diversity of opinion.

In the present volume the subject is treated with the same accuracy and fulness of detail as is apparent in its predecessors; and the beautiful illustrations afford the student every assistance possible towards a right understanding of the text. In the author's opinion, the Planarians, together with their offshoots the Flukes and the Tape-worms, collectively constituting the Platyhelmia, are regarded as standing at or near the base of the Cœlomocœla; while the Nemertine worms form a distinct "phylum," from which it is considered probable the Annelids have originated. The ideal ancestral type is taken as the best means of illustrating the structure and affinities of the Flat-worms; whereas in the Nemertines it is considered preferable to take a "central type" as the basis of description.

The Tapeworms have a special, although unpleasant interest, on account of the marvellous nature of their transformations, and the connection of several of them with the human body. In a brief historical sketch the author states that these creatures were probably known to Moses, and were certainly familiar to Aristotle, who distinguished between ἕλμινθες πλατεῖαι, or Tape-worms attached to the walls of the intestine, and στρογγύλαι, or free Nematodes. The gradual acquisition of our knowledge of the migrations and transmutations of these organisms is then referred to, after which we have an excellent series of descriptions of the life-history of the different members of the group.

So far as we can judge, the present volume is in every way worthy of the great work of which it constitutes an important and interesting section.

"BIRD WATCHING." By Edmund Selous. Haddon Hall Library. (Dent.) Illustrated.—In the preface to this volume the author apologises for so many shortcomings that to avoid repetition there seems little else for the reviewer to do but to praise. Nevertheless, although the subject matter of the book is extremely good and valuable, in our opinion Mr. Selous has practically thrown his opportunities away, and has produced a work written in so prolix a style that to read it is a tedious and almost annoying task. The bulk of the book is a mass of minute and undoubtedly accurate observations of the habits of birds, forming a record of almost every action of the birds watched at every hour of the day. Interspersed amongst these voluminous notes are excursions into theory and speculation which we need only say the author would have been well advised to omit. It is a great pity that the author's powers of observation, or "watching," to use the word he prefers, which have been well used, should have been lost to the public by a want of a little careful editing. Had Mr. Selous digested his note-books instead of printing them in full, and had he given us a narrative of the results of his digestion, the outcome would have been, we feel sure, both pleasing and profitable.

As it is we can only recommend the volume to ornithologists as a somewhat clumsy book of reference, but ornithologists should certainly possess it, since first-hand information is always of value however presented. We had no wish to further criticise Mr. Selous, but we cannot refrain from an expression of regret at his ignorant sneer at collectors, to whom if he reflected but for a moment he would realise that every naturalist owes much.

Mr. Smit has illustrated the book very nicely, but why so good a bird-artist should perpetuate with his pencil in a book of facts such an ancient fable as that of the stork transporting small birds over the sea passes comprehension. Mr. Smit has drawn the stork with its wings raised, and five thrushes comfortably sitting in the hollow of its back. How would the artist have the trick performed when the stork's wings are making the down-stroke?

"THE EVOLUTION OF SEX." By Prof. Patrick Geddes and J. Arthur Thomson. Revised Edition. (Walter Scott.) 6s. Illustrated.—This is a revised edition of a book which appeared twelve years ago and has attracted the attention of many students of biology, both on account of its exceptional originality, and, if we may say so, because of the bearing of matters with which it deals upon the cytological work of recent years. The fundamental cause which has led to the differentiation of sex is considered by the authors to be difference of metabolism. All changes which occur in the body can be referred to the metabolism of protoplasm, and the ratio of the constructive to destructive processes is variable, the former preponderating in females and the latter in males. In most cases females are relatively more passive than males, that is, they do not spend so large a proportion of energy in active habits. Moreover, observations and experiments show that conditions favourable to constructive processes—anabolic conditions as they are called—tend to produce femaleness of offspring, while the opposite, or katabolic, conditions tend to produce males. Nutrition is thus an important factor in determining sex, but there are many other factors, such as temperature, age of parents, etc., and their influence is slowly being understood. This is a general statement of the thesis which Professors Geddes and Thomson seek to establish. As can easily be understood, the subject is a very intricate one, as well as of deep interest, because it goes to the root of the explanation of biological differences. To our thinking, however, a large part of the book is not directly connected with the evolution of sex, and a sub-title expressing the fact that the development and inheritance of the cell and of the individual might be added with advantage. A misprint occurs on p. 58, where females are said to be relatively more katabolic than males, whereas the reverse is the case.

"OUR COUNTRY'S SHELLS AND HOW TO KNOW THEM: A GUIDE TO THE BRITISH MOLLUSCA." By W. J. Gordon. 33 plates. (Simpkin.) 6s.—The first part of the title very accurately indicates the scope of the book, which will be found invaluable to those who are making collections of the shells of the native mollusca and desire to be able to classify and name them. The schemes of identification are very well arranged, and the descriptions of species supply all the necessary information. The illustrations, by A. Lambert, are excellent. The thirty-three coloured plates give representations of all the British species having shells; and the black-and-white diagrams fulfil their purpose no less satisfactorily. The style of the letterpress is bright and interesting, but the author often uses undefined technical terms which will embarrass the beginner. The glossary at the end is a necessary feature. A very scrappy account only is given of the physiology and internal anatomy of the mollusca. The book would have been materially improved by a preliminary chapter giving exact instructions for dissecting two or three common types, with simple explanations of the duties of the various organs. We are glad to notice the table of synonyms on pp. 63 and 64.

"KNOWLEDGE DIARY AND SCIENTIFIC HANDBOOK FOR 1902," the second year of issue, is now published. In the Diary portion of the work a whole page is provided for the observations of each day, while there are separate pages for monthly notes, indexing, and other objects. The following features of the handbook portion should prove especially useful to workers in astronomy:—The paths of the planets for the year illustrated with maps, astronomical phenomena of the year, monthly star maps showing the positions of the constellations and principal stars, how to use an equatorial telescope, the observation of comets and meteors, and numerous astronomical tables. Other sciences are dealt with by articles on Field Botany, by Mr. R. Lloyd Praeger, The Microscope and its Uses, by Mr. M. I. Cross, and Meteorology in Theory and Practice, by Mr. Arthur H. Bell; while there is much other useful and interesting information of a more general character. The price is three shillings.

## BOOKS RECEIVED.

*Anticipations of the Reaction of Mechanical and Scientific Progress upon Human Life and Thought.* By H. G. Wells. (Chapman & Hall) 7s. 6d.

*Thought Power: Its Control and Culture.* By Annie Besant. (Theosophical Publishing Society.) 1s. 6d. net.

*Record of the Progress of the Zoological Society of London during the Nineteenth Century.* (Zoological Society.)

*Photography for Naturalists.* By Douglas English. (Iliffe.) Illustrated. 5s. net.

*Roads: Their Construction and Maintenance.* By Allan Greenwell, A.M.I.C.E., F.G.S., and J. V. Elsden, B.SC., F.G.S. (*Builder* Office.) 5s.

*Geometric Exercises in Paper Folding.* By T. Sundara Row. Kegan Paul, Trench, Trübner & Co.) Illustrated. 4s. 6d. net.

*General History of Europe (350-1900).* By Oliver J. Thatcher, PH.D., and Ferdinand Schwill, PH.D. (Murray.) 9s.

*Voices of Nature and Lessons from Science.* By Caroline A Martineau. (Sunday School Association.)

*Studies in Heterogenesis.* By H. Charlton Bastian, M.A., M.D., F.R.S. (Williams & Norgate.) Illustrated. 7s. 6d.

*Medicine.* By Christabel Osborn. (Scott.) 1s.

*Practical Science.* By J. H. Leonard, B.SC. (Murray.) 1s. 6d.

*Treatise on Photography.* By Sir William de Wiveleslie Abney, K C.B., D.C.L., F R.S. (Longmans.) Illustrated. 5s.

*Book of the Dead.* (Books on Egypt and Chaldæa.) By E. A. Wallis Budge, M.A. (Kegan Paul.) 3 Vols. 3s. 6d. each net.

*Pitman's Shorthand and Typewriting Year Book for 1902.* 1s.

*Algebra.* Part I. By E. M. Langley, M.A., and S. R. N. Bradley, M.A. (Murray.) 1s. 6d.

*English Composition.* By G. H. Thornton, M.A. Edited by John Adams, M.A., B.SC. (Hodder & Stoughton.) 2s. 6d.

*Lectures and Essays.* 2 Vols. By the late William Kingdon Clifford, F.R.S. (Macmillan.) 10s.

*Alcoholism: a Study in Heredity.* By G. Archdall Reid, M.B., C.M., F.R.S.E. (Fisher Unwin.) 6s. net.

*Last Words on Materialism and Kindred Subjects.* By Prof. Ludwig Büchner, M.D. (Watts & Co.) 6s. net.

*Orthochromatic and Three-colour Photography.* By James Cadett and Sanger Shepherd. (Cadett & Neall, Ashtead.)

*West Ham Public Libraries: Annual Report of the Chief Librarian for the Year ending 31st March, 1901.* (Avenue Press, Stratford.)

*Publications of the Lick Observatory of the University of California.* Vol. V., 1901. (Sacramento: A. J. Johnston.)

*On the Relation of Phyllotaxis to Mechanical Laws.* Part I. *Construction by Orthogonal Trajectories.* By A. H. Church. (Williams & Norgate.) 3s. 6d. Illustrated.

*Influence of Winds upon Climate during the Pleistocene Epoch.* By Frederick William Harmer, F.G.S. (Geological Society.)

*Mechanical Ventilators.* By M. Walton Brown. (Newcastle: Institution of Mining Engineers.)

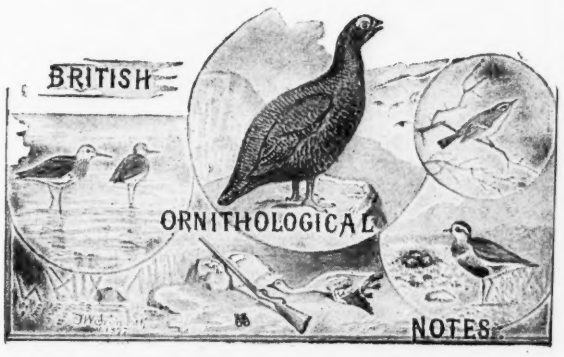
*Biometrika.* Vol. I., Part I., October, 1901. (Clay.) 10s. net.

*Photography.* Xmas Number, 1901. (Iliffe.) 1s. net.

*Rapport Annuel sur L'etat de L'Observatoire de Paris pour L'année, 1900.* (Paris: Imprimerie Nationale.)

*Pleasures of the Telescope.* By Garrett P. Serviss. (Hirschfeld Bros.) Illustrated. 6s. net.

*Journal and Proceedings of the Royal Society of New South Wales.* Vol. XXXIV., 1900. (Robertson & Co. Proprietary, Limited.)




*Conducted by* HARRY F. WITHERBY, F.Z.S., M.B.O.U.

MIGRATING SWALLOWS.—We observed the last swallows, as we thought, on October 11th. None were seen after that date till suddenly on the 29th they appeared again,—swallows and house martins—remaining in considerable numbers up to November 2nd. On that day they were swarming over this house, sitting in rows on the roof, or flying high in the air. Next day we saw one or two only, and not one after. Can these have been a north country lot on their way south? for I am sure our summer friends all left on the 11th October.—L. M. SABINE PASLEY, Botley Hill, Botley, Hants.

[The swallows which visited Miss Pasley were undoubtedly migrants from the north, and simply broke their journey southward for a day or two in a congenial neighbourhood. Gilbert White was continually noticing that swallows visited his neighbourhood after the Selborne birds had all disappeared, and it was this reappearance of the swallows that led one of the acutest observers of nature into the mistaken idea that the birds were really hiding in a torpid state from which they awoke in occasional spells of warm weather. Facts have converted the theory of hibernation into a mere myth, and we now know very well that although the majority of swallows and martins leave this country together a great many remain some weeks longer and proceed leisurely south in small companies, stopping here and there for food and rest.—H. F. W.]

*Breeding of the Blue-headed Wagtail in Sussex (Zoologist,* October, 1901, p. 389).—Mr. W. Ruskin Butterfield records that a nest of the Blue-headed Wagtail, containing four eggs, was found by Mr. George Bristow, junior, in a turnip field near Winchelsea, on May 31st, 1901. Three of the eggs were accidentally broken, but the remaining one with the nest and parent birds have been submitted to Mr. H. E. Dresser, and are proclaimed to be Blue-headed Wagtails. This bird is usually considered an irregular migrating visitor to our shores.

*Broad-billed Sandpiper in Kent and in Sussex (Zoologist,* October, 1901, p. 390).—Mr. L. A. Curtis Edwards records that an immature female of this rare visitor to Great Britain was procured at Littlestone-on-Sea, Kent, on August 31st; while Mr. Ruskin Butterfield records that an immature male was shot by Mr. A. C. Wendell Price on September 14th near Bexhill, in Sussex.

*Nutcracker in Yorkshire* (*Ibis,* October, 1901, p. 737).—Mr. W. Ruskin Butterfield writes to the *Ibis* that a Nutcracker was shot by a gamekeeper near Ilkley, Yorkshire, on January 5th, 1901. The bird proves to belong to the slender-billed Siberian form which migrated in great numbers last winter to Holland, Germany, and Scandinavia (*see* KNOWLEDGE, November, 1900, p. 256, and May, 1901, p. 117).

*Tawny Owl in Ireland (Irish Naturalist,* November, 1901, p. 230).—I am glad to hear from Mr. Robert Patterson that another of the Tawny Owls unfortunately introduced into Ireland (*see* KNOWLEDGE, April, 1901, p. 90) has been shot. The sooner they are all accounted for the better.

*Early Ornithologists.* By the Rev. H. A. Macpherson, M.A. (*Zoologist,* October, 1901, pp. 376-383).—This is an interesting article concerning four old-time ornithologists, William Turner, Pierre Belon, Conrad Gesner, and Aldrovandi, who flourished in the 16th century.

*Breeding Habits of the Swift.* By the Rev. Allan Ellison. (*Zoologist,* October, 1901, pp. 384-385).—The author here confirms the observations made by the Rev. Jourdain (*see* KNOWLEDGE, October, 1901, p. 234), and is of opinion that Swifts regularly lay three eggs.

***All contributions to the column, either in the way of notes or photographs, should be forwarded to* HARRY F. WITHERBY, *at 10, St. Germans Place, Blackheath, Kent.***

## FLOWERING PLANTS,

### AS ILLUSTRATED BY BRITISH WILD-FLOWERS.

By R. LLOYD PRAEGER, B.A.

### VI.—THE VEGETATION OF IRELAND.

WHEN we come to investigate and endeavour to understand the distribution of plants on a large scale—to study *vegetations,* in lieu of the plant associations which compose them—we find ourselves involved in a mass of facts on the one hand, and of hypotheses on the other, which convey an idea of the variety of phenomena involved, and the complicated questions which at once arise. Let us take as a simple example the case of a circumscribed area of reasonable size—the island of Ireland, and endeavour to obtain some idea of its

vegetation, paying a due regard to both cause and effect. Now, before we come to deal with the constitution or distribution of the flora at all, many wide questions have to be considered. Among the more important of these the following may be raised:—

1. HISTORY.—What has been the past history of the area? This involves an investigation of the evidence furnished by geology and palæontology, and by the present distribution of the fauna and flora, not only in the area under investigation, but in adjoining areas both of land and sea.

2. POSITION.—How does the area lie with regard to neighbouring land masses, from which the flora may in whole or part have migrated? The width and depth of intervening seas, and the set of currents and of winds are factors which must not be neglected.

3. CLIMATE.—A thorough knowledge of the climate of the area and of all parts of it is essential—the variations of temperature, amount of sunlight, rainfall, prevailing winds, humidity of the air—all these are important factors.

4. SURFACE.—What is the elevation and character of the surface of the various parts of the country? What mountain-barriers are there, or what barriers formed by water? The question of river-basins deserves careful attention.

5. SOILS.—The prevailing soils of the area must be noted, and this necessitates a study of the rocks from which the soils are derived. The presence or absence of lime in the soil is an especially important point.

6. HUMAN INFLUENCE.—The flora of any civilized country has been profoundly altered by the operations of man. The state and character of agriculture must be looked into, likewise the nature of the commerce of the country, and the distribution of towns and harbours, and of lines of communication of all kinds—railways, canals, roads.

Now let us sum up very briefly the leading features of Ireland with reference to these questions. As to the past history of the country, abundant evidence shows that till a time which is, geologically speaking, quite recent, Ireland formed a portion of the western edge of the Eurasian continent. That the connection which joined Great Britain to Ireland broke down before that which joined Britain to the continent as it now exists—in other words, that Ireland became an island before Great Britain did—is also clear from the evidence. But the date of this final isolation of Ireland, and the position of the final bridge or bridges, is a much more difficult question. The extended investigations of Dr. Scharff, based on the past and present fauna of western Europe, led him to conclude that "Ireland was in later Tertiary times connected with Wales in the south, and Scotland in the north; whilst a freshwater lake occupied the present central area of the Irish Sea. The southern connexion broke down at the beginning of the Pleistocene period, the northern connexion following soon after. There is no evidence of any subsequent land-connexion between Great Britain and Ireland." As to the difficulty of accounting for the survival of the flora throughout the Great Ice Age, if the date of the breaking down of the final connexion is pushed so far back, we need not concern ourselves at present; we are at least safe in assuming that the whole of the flora which arrived by land reached Ireland at latest at a date not long subsequent to the close of the Glacial Period. A few species may have arrived subsequently by wind or water, but a few centuries of human civilization have wrought more change in the flora than all the thousands of years following the severing of the land-connexion. As regards climate, the insular position of Ireland and the prevailing ocean winds are conducive to a mitigation of extremes of temperature, to a heavy rainfall, and to a high degree of humidity. The comparative coolness and cloudiness of the summer might be expected to preclude such plants as need a bright hot sun during the period of flowering and fruiting; while on the other hand, plants which cannot endure cold might flourish in Ireland—frost and snow are practically unknown on the west coast—while unable to endure the winter in the same latitude on the continent. Rainfall and humidity are much greater on the west coast, facing the ocean, than on the east. As regards surface, the island is generally low, over 77 per cent. of its area being of less than 500 feet elevation; the higher mountains—only a few points exceed 3000 feet—are generally grouped in isolated masses near the coast. We may expect, therefore, an essentially low-level flora, and a paucity of alpine plants. Most of the watersheds lie in the great plain which fills the centre of the island, and are of quite low elevation, so no marked difference between the floras of adjacent river-basins need be expected. As to rocks and soils, the Central Plain consists of an almost uninterrupted stretch of Carboniferous limestone, and as this is not broken up by hills, a uniformity of flora may be looked for here. Elsewhere a variety of rocks occur. The most important of these are the ancient granites and schists of Donegal, and of Mayo and Galway, the Old Red Sandstone mountain-ribs of Kerry and Cork, the granite chain of Leinster, the Silurian area of south-eastern Ulster, and the Tertiary basalt-plateau of the north-east. Thus the well-marked group of calcicole or lime-loving plants may be expected to occur chiefly in the central parts of Ireland, while calcifuge or lime-avoiding species will have their head-quarters in Ulster and generally near the margins of the island. Lastly, as to human influence. About 75 per cent. of the surface is subject to the influence of husbandry—devoted to tillage or grazing, the percentage decreasing with some rapidity from the eastern side towards the wilder western regions—so that we may expect to find the natural distribution of many plants interfered with, and many others introduced deliberately or accidentally, especially in those eastern portions, where agriculture most prevails. The railways and canals which run in many directions across the country may be expected to provide an artificial means of dispersal for both native and introduced species.

Let us now view the flora of Ireland in the light of these facts. This may be best done by examining the vegetation of certain selected areas, distinguished by physical or phytological peculiarities; these will supply the leading features which would become evident from a survey of the whole. The areas which we will select are—(1) The east coast; (2) the north-east; (3) the limestone plain; (4) the south and west coasts.

THE EAST COAST.—The conditions prevailing here which might affect plant life are generally as follows:—England and Wales are distant only 50 to 150 miles across the Irish Sea; the rainfall is comparatively small, and the soils comparatively light and dry; limestone does not prevail; the tillage is at its maximum as regards Ireland. These conditions have a due effect on the flora. This eastern strip, from Louth to Waterford, is the head-quarters of a group of plants which in the warmer drier climate and lighter soils of

*Proc. Royal Irish Academy* (3), Vol. III., 1894.

England have a wide distribution—such are the Flixweed (*Sisymbrium Sophia*), *Trifolium glomeratum* and *T. scabrum*, *Trigonella ornithopodioides*, *Senecio erucifolius*, and the grass *Festuca uniglumis*. The calcicole group is poorly represented; and plants of cultivation —denizens and colonists—occur in profusion. Generally speaking, the flora of this area resembles that of the adjoining portions of Great Britain, as might be expected from its position, and from the similarity of physical conditions. No doubt the plants peculiar to this eastern shore-line reached Ireland with numbers of others across the former land-connexion from England, but being less adaptable, they remained and colonized this region, while hardier species pushed westward; possibly some of them were among the latest arrivals, and found their passage westward disputed by stronger species which already occupied the ground.

THE NORTH-EAST.—The peculiarities of this area are mainly geological. In Eocene times a period of great volcanic activity resulted in the formation of bed upon bed of lava, which eventually formed a high plateau covering the greater part of Antrim and Derry, and extending far over the present North Channel. This plateau, now much reduced in extent, dislocated and weather-worn, still forms a wide area of high heathery hills, fringed with steep escarpments, and intersected with deep-carved valleys, in which the decayed lava has formed a rich soil. Climate has also influenced the flora. Phytologically and zoologically, this is the extreme north of Ireland, rather than Donegal, though the latter reaches a higher latitude. In Donegal the influence of the warm Atlantic currents is clearly felt; in the north-east both land and sea are colder. Then there is, besides, the proximity of Scotland, allowing of easy colonization in times of former land-connexion. So we should expect to find here, and we actually do find, that certain northern and characteristically Scottish plants form a marked feature of the flora, such as *Sagina subulata*, *Arenaria verna*, *Geranium sylvaticum*, *Vicia sylvatica*, *Circæa alpina*, several species of *Pyrola*, *Melampyrum sylvaticum*, *Orobanche rubra*, *Equisetum pratense*. But while Antrim possesses a larger number of plants of this type than any other portion of Ireland, it is worthy of note that most of the Scottish type plants have a wide though often discontinuous range in Ireland. With Antrim, Derry and Donegal as headquarters, they spread chiefly down the west coast, decreasing eastward, and reaching their minimum in the south-east. Physical conditions no doubt account in part for this distribution, but further reasons are needed to explain the paucity of these plants on the highlands and rough ground of, for instance, Wicklow and Waterford.

THE LIMESTONE PLAIN.—The wide stretch of low land which occupies the centre of Ireland extends from the Irish Sea at Dublin to the Atlantic Ocean at Galway, and northward and southward for fifty miles in either direction. It consists of an almost unbroken area of Carboniferous limestone; whatever newer rocks may have been at one time or another laid down on this ancient floor have been removed by denudation, so that now the deposits of the Glacial epoch, and the great turf bogs, alone cover its nakedness. In the west large areas are actually devoid of all covering, and present to the eye grey wildernesses of gnarled and fissured rock. The centre is largely occupied by huge swelling bogs, while green sinuous esker-ridges give a peculiar character to the scene; and in the east the glacial deposits are especially well developed. A number of large lakes are irregularly distributed. Though characterized by an absence of most of those species which form the leading features on the east and west coasts, the flora of this large area is tolerably homogeneous, and has a character of its own. In the first place, the great predominance of limestone has its due effect, calcicole plants forming a conspicuous feature; and the quantity of lake and marsh produces a large variety of lacustrine and paludal species. Light-soil species are few, and chiefly haunt the esker-ridges; and plants of the uplands are almost wanting. The great bogs, formed entirely of vegetable matter, are a most striking feature. These presumably arose around springs on the limestone floor, which provided a perennial supply of moisture. The patch of marsh plants around such a spring increased in size, and by its growth tended to retain the water; presently bog plants, such as Bog-mosses (*Sphagnum*), Bog-bean, Bog Asphodel, Bog-Cotton, established themselves; the spring was soon buried, but fed the colony from beneath. It spread steadily. The more rapid growth of the central wetter parts caused its surface to eventually assume the form of an inverted saucer set on a flat table; the formation of a felty crust allowed of the growth of Ling, Crow-berry, and other heath plants. The shelly deposits underlying the bogs show that often they have originated around lakes, which they have filled up and covered over with a deep deposit of peat; the straggling stunted patches of *Phragmites*, *Cladium*, and such plants, not bog plants proper, which one sometimes finds far out on the great bogs, are very possibly the surviving remnant of a buried lake-flora. The flora of the bogs varies according to the amount of moisture present in the surface layer. On the wettest bogs, among a luxuriant growth of *Sphagnum*, we find the Cranberry, Bog-bean, White Beak-rush, the sedge *Carex limosa*, and the various Sundews. The bog of average wetness has a flora composed chiefly of Ling, Bell-Heather, Marsh Andromeda, Bog Asphodel, Bog-Cotton, *Scirpus cæspitosus*, with Sundews and White Beak-rush along the pool-margins. On the driest bogs the Ling grows exuberantly; Bracken and Birch, and even Brambles, put in an appearance, and most of the plants in the previous list disappear. Where the peat is drained and the original vegetation destroyed, as where the bog has been cut for fuel, plants of quite another kind, such as *Senecio sylvaticus*, *Rumex Acetosella*, and *Aira caryophyllea*, colonize the ground. Whether wet or dry, the bog-soil is quite free from lime, even when resting on limestone, and supports many strongly calcifuge plants. In striking contrast to the bogs with their peculiar plant-association, and often interspersed between them, we have the limestone pavements and limestone lake-shores of the western lowlands. The bare rock occupies a large portion of the surface; but in the cracks and crevices the gradual dissolution of the limestone and of vegetable matter has caused a rich soil to collect, which supports a highly interesting flora. Of its most peculiar members consideration must be reserved until the next paragraph. Curiously enough, many of the characteristic plants are not by any means in their general distribution especially partial to limestone—such, for instance, are the Bloody Crane's-bill, *Thalictrum collinum*, the Madder, Bearberry, Mountain Avens; and some reason other than their calcareous surroundings must be sought to account for their remarkable abundance here.

THE SOUTH AND WEST COASTS.—Speaking generally, the conditions prevailing along the west coast of Ireland are as follows:—The country is formed of old rocks,

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giving a rugged surface and a bold and irregular coast-line; tracts of limestone, generally of low elevation, alternate with bolder masses of metamorphic and igneous rocks; the exposure is great; the air moist and warm on account of the adjoining ocean and the

FIG. 1.—Distribution of Northern Plants (Watson's Scottish and Intermediate Types) in Ireland.

FIG. 2.—Distribution of Pyrenean and Mediterranean Plants in Ireland.

prevalence of westerly winds; there is a high rainfall and much cloud; glacial deposits are frequently absent. The effect of these conditions is to reduce the amount of cultivated land and of woods; to increase the area of bog and moor; and as regards the character of the flora, to decrease the number of plants that love a light soil, a dry climate, or abundance of sunlight; and to increase the number of mountain plants, and of species averse to the rigour of hard winters. Here the artificial element of the flora-weeds of cultivation, and introduced plants of all kinds—is at its minimum; in marked contrast to the east coast, the flora of large areas is strictly natural, uninfluenced by the works of man. Among this virgin vegetation we find a group of plants—indeed, several groups of plants—which at once arrest attention by their unfamiliarity. Some of these are widely spread along the western sea-board; others discontinuously distributed; while a few have a limited local range. Most of these plants are unknown, not only in the rest of Ireland, but throughout Great Britain as well. Investigation shows that they can be divided into three groups, of widely different origin:—(1) Plants whose head-quarters is in the Pyrenees or along the Mediterranean; (2) plants characteristic of the northern part of North America; (3) plants usually occurring in alpine situations, but here growing right down to sea-level. Particulars regarding the distribution of some characteristic members of each of these groups will emphasize the remarkable character of these elements of the flora:—

SOUTHERN PLANTS.—*Saxifraga umbrosa.*—In Ireland, widely spread along south and west coasts from Waterford to Donegal, avoiding the limestone. Unknown in Britain. Elsewhere confined to the Spanish Peninsula.

*Saxifraga Geum.*—Frequent in extreme south-west. Unknown in Britain. Elsewhere restricted to the Pyrenean region.

*Arbutus Unedo.*—Extreme south-west. Unknown in Britain. Widespread in the Mediterranean region.

*Pinguicula grandiflora.*—Common in the south-west. Unknown in Britain. Elsewhere confined to the Spanish Peninsula and the Alps.

*Erica mediterranea, E. Mackaii, Dabeocia polifolia.*—Three heaths confined to West Galway and Mayo. Unknown in Britain. Elsewhere found only in South-west France and Spain; the last-named extending to the Azores. Note that two other heaths, *E. ciliaris* and *E. vagans*, in the British Isles found only in the south-west of England, have the same distribution on the Continent.

*Euphorbia hiberna.*—Common in the south-west and extending thence discontinuously to Donegal. Devon only in Britain. Elsewhere confined to Pyrenean region.

*Habenaria intacta.*—Widespread on the western edge of the limestone from Clare to Mayo. Not in Britain. Elsewhere in Mediterranean region and Asia Minor.

NORTH AMERICAN PLANTS.—*Spiranthes Romanzoffiana.*—Found in Cork, also in the north-east. Unknown elsewhere in Europe. Of frequent occurrence in Canada and the northern United States, and in Kamtschatka.

*Eriocaulon septangulare.*—Spread along the west coast from Cork to Donegal. On one island in Scotland (Skye). Unknown on the European continent. Widespread in northern North America.

LOW-LEVEL ALPINES AND NORTHERN PLANTS.—The most remarkable display of these is on the bare limestone hills of North Clare, and the low limestone pavements adjoining, where *Dryas octopetala, Gentiana verna, Arctostaphylos Uva-ursi, Sesleria cærulea,* and similar plants grow, often in marvellous profusion, right down to sea-level.

As regards this third group, the peculiar climatic conditions must be held accountable for their abundance

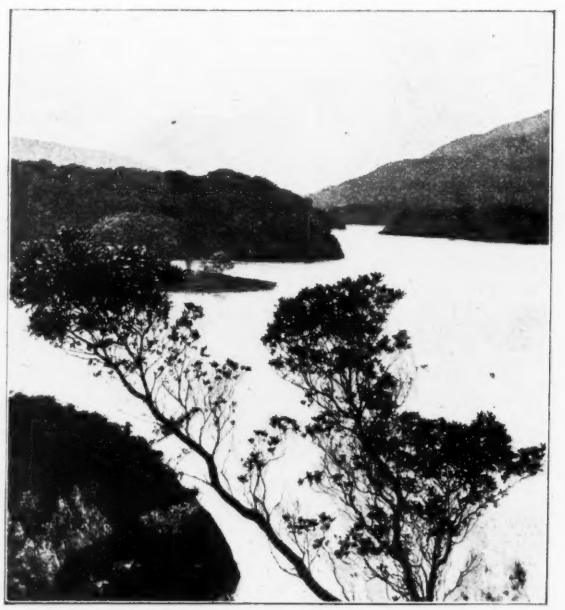


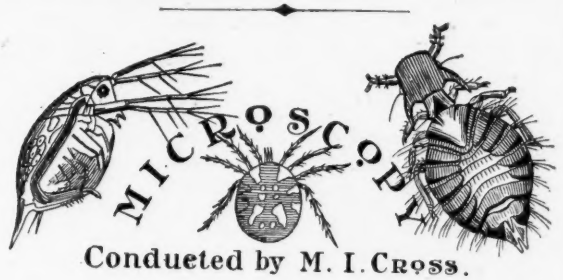
FIG. 3.—Wild Arbutus at the Upper Lake, Killarney. Macgillicuddy's Reeks (3414 feet) in the distance.

[R. WELCH, *Photo.*

here—the exposure and dampness which characterize the western coast apparently mimicking the conditions which prevail in their accustomed highland haunts. But considerations of a meteorological kind, though they may help to account for the extraordinary mixing

together of the northern and southern groups on the west coast, will not explain the presence of the Pyrenean or American plants. Any suggestion of introduction—early accidental introduction, say, owing to trade with Spain, or owing to seed borne across the Atlantic by the Gulf Stream—will not for a moment be allowed by botanists. These plants are native of the natives, growing abundantly in the wildest parts of the country, and avoiding the haunts of man. Neither does it appear possible that they colonized Ireland by means of the land-bridge to the eastward, which has been spoken of, for they would have left some traces of their former occupation of the wide areas over which they must have passed. To account for the presence in the flora of Ireland of the Spanish and Mediterranean elements, we must look to a period far back in the history of the island, when the continental edge extended further westward than at present, and allowed migration to proceed from the Peninsula northward across the extreme west of England into Ireland; and for the American plants, we must assume a former land-connexion across the North Atlantic, probably by way of Greenland and Iceland, joining the American with the Eurasian continent. At what period these lost lands existed it is not, with our present knowledge, possible to determine, but the distribution of these plants, and the discontinuity of their range, justify us in putting it back to a time antecedent to the arrival of the bulk of the vegetation as we now know it, and in looking upon these species as some of the very oldest components of the British flora, the remnant of an army, the date of whose invasion is lost, whose retreat has been long since cut off, and who, reduced in numbers, have been allowed, by peculiar climatic conditions, to remain to tell us of past times.

To sum up, then, the flora of Ireland may be looked on in a general way as a reduced English flora, just as the English flora may be considered as a reduced West European one; in both cases the reduction is mainly due to the breaking down of land-connections before the arrival of the whole of the plants from the great continental area to the eastward. The bulk of the flora consists of these eastern plants, most of which have colonized the entire island, though a few have not got further than the eastern margin. Northern plants arrived by way of Scotland, and spread widely, chiefly down the western side. Lastly, in the west and south we find traces of a very old flora which has migrated, probably owing to fluctuations of climate, along the former continental edge from the south-west of Europe, and also over lands long since destroyed from the distant shores of sub-arctic America.




## Conducted by M. I. CROSS.

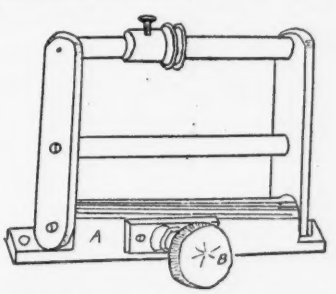
MICROSCOPES IN SCHOOLS.—During the last few months, the development of the system of "Nature teaching" in elementary schools has led to enquiry as to the most serviceable form of microscope for further developing the subject. In Scottish schools in particular, this work is to become a part of the regular curriculum, and it has been said that every school will be provided with at least one microscope, so that the senior scholars may pursue their studies in a thorough manner. In England encouragement is being given by the issue of Teacher's Leaflets of "Nature Knowledge," by the Agricultural Education Committee.

One of the main objects attempted to be achieved by these leaflets is to lead the teacher to cultivate the faculty of observation, to trace cause and effect, and to become acquainted with life-histories and processes of evolution and development. If students acquire the habit of observation, they will quickly learn to think, and an added interest will be imparted to their studies by bringing them into actual touch with the secrets which the microscope can alone reveal.

It would seem almost a pity to give the scholars a compound microscope at too early a stage; pages could be written on the unnoticed structure which can be seen with a pocket lens, and it would be well that the work should be graded, and that before a compound microscope is used the worker should have acquired a facility with the pocket lens.

There is no doubt that this new study will receive encouragement, will be appreciated by the scholars and grow to large dimensions, and it will be for English microscope makers to anticipate the requirements by providing suitable instruments of sound but plain construction, and at a sufficiently moderate price; in fact, in a degree the success of the scheme so far as microscopy is concerned depends on the willingness of makers to do their part. It is impossible to foretell the influence which such teaching may have on the future of the country scientifically, and it is not improbable that it will in time to come bring an army of workers into the ranks of microscopists, and serve to re-create the interest which it is considered by many is dormant amongst amateurs at the present time. This is essentially a British movement, and if British makers supply the simple instrument, they will in due time be requisitioned for the more complete outfits which will be necessary in consequence of the desire for fuller knowledge and investigation engendered by the elementary teaching.

FOCUSSING ATTACHMENTS TO PHOTO-MICRO. CAMERAS.—Many ideas have been formulated for making an effective connection between the microscope fine adjustment and the long rod which actuates it from the end of the photo-micrographic camera. These have consisted principally of an endless band passing round the milled head of the microscope and a similar head attached to the rod of the camera; or a friction gear, in which a wheel shod with india-rubber is arranged to engage with the microscope milled head; or a cord carried over the microscope milled head and over pulley wheels on either side of the base board having weights at the two ends, practically another form of friction movement. In practice the endless band has been the favourite, but it has possessed one drawback—it cannot be readily detached from the microscope. This difficulty was overcome by the cord with weighted ends. A very neat and simple fitting has been contrived by Mr. E. B. Stringer, which




overcomes the obstacle with the endless band. The usual milled head of the camera rod, around which the cord is passed, is mounted on a frame the lower portion of which fits into a sleeve, permitting of the rod on which the milled head is carried being tilted forward when the band is to encircle the fine adjustment milled head, or to be removed; the band is then made taut by setting the fitting vertical again, a clamping screw being provided for securing it. In this position the long camera rod

connects with it and actuates it. A reference to the accompanying illustration will make the matter clear :—A is a sleeve in which the upper part of the frame is supported and can be moved forward or backward. B is the clamping screw with which it is held in position.

It may be mentioned that two or more milled heads of different sizes will often be found useful on the camera rod, for they will permit of the rate of movement being increased or diminished as may be desired.

A NEW SUBSTAGE CONDENSER. — Several writers have advocated the use of a good low-power Substage Achromatic Condenser, but nothing that really filled the gap was obtainable until the introduction of Mr. C. Baker's new condenser, referred to in the April number of KNOWLEDGE. Zeiss's Achromatic Condenser was right so far as it went, but it had several disadvantages. It was large—too large—and restricted the movements of the mechanical stages, also it yielded an aplanatic aperture of less than ·70, yet the fact of its having a power of ½-inch caused it to be appreciated, and largely used. Messrs. Watson & Sons have just introduced a new condenser having a power of $\frac{5}{10}$-inch, and a numerical aperture of ·99, which is practically totally aplanatic. This will be found a great auxiliary to the range of condensers, especially as it possesses a sufficiently large field-lens, and is not so bulky in the mounting as to obstruct the moving plates of the mechanical stage. There is quite a comfort in using a condenser of this power with objectives of low and medium magnification.

AN EXPERIMENTAL OFFER.—There are many microscopists possessing experience who are interested in every new development, and to such, an opportunity for practically testing new apparatus would be acceptable and valuable. I have one of these new condensers of Watson's in my possession, and I am willing to send it for trial to the first four applicants who are regular subscribers of KNOWLEDGE who requisition it. I will only stipulate that it shall not be retained more than four days, and returned carefully packed. If this experiment is appreciated, it may be possible to make similar offers concerning new items of apparatus that may be described from time to time, should the makers of apparatus be willing to co-operate. I should be glad to receive suggestions and expressions of opinion on the extension of this scheme.

OBJECT MARKER.—A very neat accessory, and one that is frequently required, is a means of indicating by a mark on the specimen cover exactly where a particular structure that has been observed can be found again. Leitz makes such a fitting which replaces the objective after the required portion of the object has been found. The front portion of the marker is then brought into contact with the object, and a mark is made upon it which indicates for the future the position of the particular structure. Its cost is very small.

## NOTES AND QUERIES.

*J. Ogilvie.*—If you want the very best ½-inch objective that can be obtained you must have Zeiss's Apochromatic. The Holoscopic lenses of Watson's are not so well corrected for colour as the apochromatics, but are exceptionally good, being very free from spherical aberration. As you already appear to have a very good lens of this power, the better way would be to arrange with the makers for an opportunity of examining their objectives, and you could then decide whether or no you would benefit by having a new lens. I can give you no information about the other person you name.

*J. E.*—The ⅔ in. 6 mm., and ½ in. 4 mm. apochromatic objectives by Zeiss are certainly superior to all other lenses that are made. To derive benefit from them experience and skill are necessary; presuming that you possess this you would certainly do better with either of these than with the other that you already have, although that is a very good lens. You have to remember that special compensating eyepieces have to be used with apochromatic objectives. You have nothing to fear on the score of oxidation, the material now used is quite safe and permanent in the United Kingdom.

*W. H. D. M.*—I fully appreciate the value of your suggestion, which has, however, been anticipated. A further reference to the subject will be made in the next issue.

*Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to* M. I. CROSS, KNOWLEDGE *Office*, 326, *High Holborn*, *W.C.*

## NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

COMETS AND THEIR DISCOVERY.—Brief reference was made last month to the exceptional dearth of comets in 1901. Whether this rarity is to be attributed to actual scarcity or to inadequate searching for these bodies is not clear, for we have no statistics bearing directly on the work and its results. That certain observers are engaged in specially sweeping for new comets we know by occasional announcements of their success, but we have no figures showing the extent to which these labours are pursued. Quite possibly there has recently been a want of thoroughness in the quest for these bodies; if so, it would fully account for their comparative absence in our nocturnal skies. Only one new comet has been observed during the present year, and only one of the many periodical comets known has been re-detected. It is true that the comet which suddenly appeared at the end of April and formed such a brilliant appearance in the southern hemisphere must be considered quite a notable object of its class, and it made ample amends for other shortcomings in the number of cometary phenomena; but it was scarcely visible at all in the northern hemisphere. The only other comet seen was Encke's and this faintly and inconveniently displayed itself in the morning twilight of August and September, so that very few, if any, observers in this country saw anything of it. Practically, therefore, there has been nothing in the world of comets for northern observers to see during the present year. Yet these bodies are, as Kepler said, "as numerous as the fishes in the sea," and the late Dr. Kleiber found from a theoretical investigation that the mean number of comets always present within the limits of the solar system is 5934! It is a matter for regret that comet seeking is comparatively little pursued in England. The climate, it must be confessed, is not favourable for this or indeed any kind of astronomical work, but Caroline Herschel more than a century ago proved what could be accomplished in this attractive branch of observation with a very small telescope in able and patient hands. There is really no effective reason why English observers should not furnish a fair proportion of cometary discoveries, and the fault is to be found more in want of inclination and effort than in lack of opportunity. No doubt comet seeking, to be productive, demands a large amount of systematic and persevering application, and amateurs are seldom in a position to devote themselves to it with the necessary thoroughness. Many of them undertake a little sweeping at odd times, but are led to relinquish the work after some unsuccessful attempts. Sometimes this is brought about by the great prevalence of nebulæ, which form a serious hindrance to expeditious sweeping and occasion many difficulties, due to the necessity for ascertaining positions and making troublesome references and comparisons, so that the various objects may be identified whenever they are encountered. In Virgo, Coma Berenices and Ursa Major nebulæ present themselves in almost every sweep, and the observer is apt to get bewildered, and often finds it impossible to proceed satisfactorily. In many other parts of the firmament, however, conspicuous nebulæ are rare, and sweeping may be done with little interruption. The work becomes very entertaining after a little practice has smoothed away the difficulties, for the prospect of making a discovery is always alluring, while the very interesting objects which pass through the field serve to maintain the interest.

SHOWERS OF TELESCOPIC METEORS IN THE DAYTIME.—Nearly every year brings us an additional record of a daytime shower of telescopic meteors (?). Mr. J. Coles, of Liphook, Hants., has just published an account of an event of this kind which he witnessed on the afternoon of September 18th last, while viewing Arcturus in a 7-in. Newtonian reflector. He says the meteors crossed the field from W. to E. at the rate of twelve a minute. A large number of descriptions might be quoted from scientific journals relating to similar showers. Thus in the *Astronomical Register* (October, 1870) Mr. C. Grover, of London, says that on July 24th, 1870, at 10h. 15m. a.m., while examining Mercury, then close to the sun, luminous objects were seen passing through the field. Sometimes ten were counted at the same instant. They varied in size from mere points to bodies fully equal the apparent diameter of Jupiter, and had sharply-defined discs, but a few were irregular. They were passing for half an hour. He used a 12¼ in. equatorial reflector. Mr. W. R. Brooks, in the *Sidereal Messenger* (Vol. II., No. 10), says that on November 28th, 1883, while sweeping about 10° over the sunset point, he observed a wonderful shower of telescopic meteors. Most of them left a faint train visible in the telescope for one or two seconds. The motion of the majority was to the northward, but with an occasional group moving southward.

There is every reason to suppose that in these and other cases the objects observed were of purely terrestrial origin, and of so light a texture that they had risen to a considerable height and were carried

along by wind currents. The writer, at Bristol, has observed about a dozen good examples of these daytime showers, and they occur pretty frequently, though often eluding observation. They are formed by buoyant seeds, thistledown, snow or gossamer webs, and cannot be mistaken for "telescopic" meteors by anyone who carefully notes all the details of such apparitions. Their directions are not parallel across the field, the flights of certain particles being greatly inclined to others. The velocities are different in individual cases, some of them halt in mid-field, and then suddenly run on again at a different angle. They are objects of irregular form, requiring a focus as for a not very distant terrestrial object. They cross the field in the same general direction as the wind prevailing at the time. Occasionally the showers last for several days, and a change of wind brings about a corresponding variation in their directions. In fact the whole aspect and behaviour of the particles most obviously indicate their terrestrial nature, and prove them to be irregularly shaped sunlit objects, drifting along on the wind, and influenced by all its vagaries. The writer hopes during the ensuing year to make a daily search for these daylight showers with a view to ascertain their frequency, and the particular nature of the objects composing them.

FIREBALL OF OCTOBER 11.—Mr. Alex. Foote, writing from St Andrews, Fife, says that at 8.30 p.m., he observed a fireball of great size, length and brilliancy in the northern sky. It was directed from near Capella, and disappeared among the stars of the Lynx. The colour was intense white with a tinge of blue. The meteor moved very slowly, and made a distinct fizzing noise, but there was no explosion.

## THE FACE OF THE SKY FOR DECEMBER.

By A. FOWLER, F.R.A.S.

THE SUN.—On the 1st the sun rises at 7.46, and sets at 3.53; on the 31st he rises at 8.8, and sets at 3.57. Winter commences at 1 P.M. on the 22nd, when the sun enters Capricornus.

THE MOON.—The moon will enter last quarter on the 2nd at 9.50 P.M., will be new on the 11th at 2.53 A.M., will enter first quarter on the 18th at 8.35 P.M., and will be full on the 25th at 12.16 P.M. The more interesting occultations visible at Greenwich are indicated in the following table:—

| Date. | Name. | Magnitude. | Disappearance. | Angle from North. | Angle from Vertex. | Reappearance. | Angle from North. | Angle from Vertex. | Moon's Age. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ° | ° | | ° | ° | d. h |
| Dec. 14 | β Capricorni | 3·4 | 6.43 P.M. | 42 | 9 | 7.39 P.M.* | 278 | 241 | 3 16 |
| ,, 18 | λ Piscium | 4·7 | 7.24 P.M. | 11 | 353 | 8.9 P.M. | 297 | 272 | 7 17 |
| ,, 23 | B.A.C. 1361 | 6·5 | 4.30 P.M. | 6 | 47 | 4.45 P.M. | 333 | 14 | 12 14 |
| ,, 23 | ε Tauri | 3·7 | 5.53 P.M. | 9 | 50 | 6.12 P.M. | 330 | 11 | 12 15 |
| ,, 27 | $A^3$ Cancri | 5·8 | 10.42 P.M. | 105 | 141 | 11.50 P.M. | 287 | 317 | 16 20 |

* Star below horizon.

It will be seen that three stars brighter than fifth magnitude will be occulted at very convenient hours of the evening during the month.

THE PLANETS.—Mercury is a morning star throughout the month, but after the first few days will be difficult to recognise with the naked eye.

Venus remains an evening star, and reaches her greatest easterly elongation of 47° 15′ on the 5th; at this time the planet sets at 7.14 P.M., or more than three hours after the sun. On the 31st she sets at 7.55 P.M. The apparent diameter increases from 24″ at the beginning of the month to 35″ at the end.

Mars, Jupiter, Saturn, and Uranus are too nearly in line with the sun for observation, Uranus being in actual conjunction on the 9th. On the 15th the heliocentric longitudes of the earth and these four planets are respectively 83, 303, 292, 288, and 257 degrees, from which it will be obvious that the planets are almost in line with the sun, and on the further side of it as seen from the earth.

Neptune is very favourably situated during this month, being in opposition on the 22nd. He crosses the meridian at 1.26 A.M. on the 1st, and at 11.21 P.M. on the 31st. The motion of the planet is retrograde, or westerly, in the most westerly part of Gemini. The nearest bright stars are η and 1 Geminorum, the relative positions being indicated by the following table:—

| Date. | Neptune. | | η Geminorum. Mag. 3·2—4·2. | | 1 Geminorum. Mag. 4·3. | |
|---|---|---|---|---|---|---|
| | R.A. h. m. s. | Dec. ° ′ | R.A. h. m. s. | Dec. ° ′ | R.A. h. m. s. | Dec. ° ′ |
| Dec. 7 | 6 2 12 | 22 15 | | | | |
| ,, 15 | 6 1 14 | 22 15 | 6 9 0 | + 22 32 | 5 58 12 | + 23 16 |
| ,, 23 | 6 0 16 | 22 15 | | | | |
| ,, 31 | 5 59 17 | 22 15 | | | | |

Observers who are not provided with equatorials will find it easiest to identify the planet when it is near the meridian; under these circumstances the telescope should be first directed to 1 Geminorum, and left at rest for an interval of time equal to the difference in right ascensions of the star and planet, and then it should be depressed by an amount equal to the difference of declinations, estimating this from the previously determined diameter of the field of view.

THE STARS.—About 9 P.M., at the middle of the month, Cancer, Gemini, and Canis Minor will be towards the east; Auriga high up towards the east; Taurus and Orion towards the south-east; Perseus and Cassiopeia nearly overhead; Aries and the head of Cetus in the south; Andromeda high up towards the south-west; Pegasus nearly due west; Cygnus and Lyra in the north-west; and Ursa Major a little east of north.

Minima of Algol occur on the 16th at 9.47 P.M.; and on the 19th at 6.36 P.M.

## Chess Column.

By C. D. LOCOCK, B.A.

**Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.**

Solutions of November Problems.

No. 1.

(By W. Clugston.)

1. Kt to Q6, and mates next move.

No. 2.

(By D. L. Anderson.)

*Key-move.*—1. Q to B5.

If 1. . . . P×Q, 2. B×Bch.
1. . . . Q to R4, 2. P to B5ch.
1. . . . P to B4, 2. Q to Q5 mate.

[After many of Black's first moves, White has a choice of continuing by 2. P to B5ch, or 2. Q to K5ch, or 2. B×B.]

CORRECT SOLUTIONS of both problems received from W. Nash, J. Baddeley (both of whom point out that in Mr. Laws' October problem there was a mate on the move after 1. . . . P to Q4), C. C. Massey, W. Jay, G. Groom, W. de P. Crousaz, S. G. Luckock, Alpha, G. W., G. W. Middleton, W. H. S. M., H. Le Jeune, A. C. Challenger,

XUM

J. E. Broadbent, H. Boyes, C. Johnston, Vivien H. Macmeikan, F. Dennis.

Of No. 1 only from G. A. Forde (Capt.), A. E. Whitehouse.

*Alpha.*—It was quite understood from your previous letters that you were not a serious competitor.

*P. H. Williams.*—Many thanks for your pretty problems. They are marked to appear in the February number.

*S. G. Luckock.*—Although there is, in my own opinion, no objection to the insertion, during a solution tourney, of a problem composed by one of the competitors, it is nevertheless possible that some of the competitors might hold a different opinion. I have accordingly reserved your clever problem for next month, when the solution tourney will, except for possible ties, be no longer in progress.

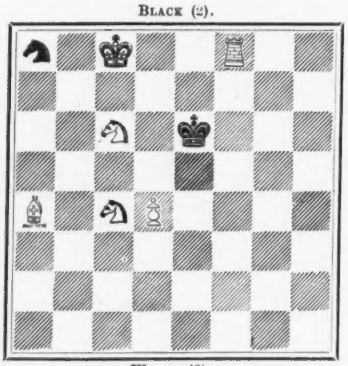
*V. H. Macmeikan.*—Your solutions were in plenty of time, the Sandwich postmark being the 9th. The mark of the issuing office must be not later than the 10th.

## PROBLEMS.

By C. D. Locock.

### No. 1.

BLACK (2).

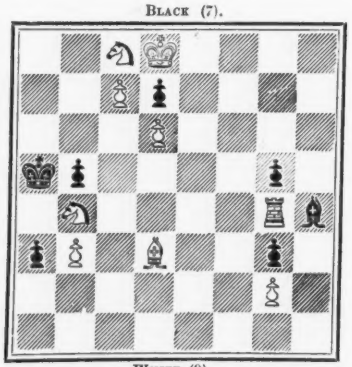


WHITE (6).

White mates in three moves.

### No. 2.

BLACK (7).



WHITE (9).

White mates in three moves.

[Solvers are requested to notice that both the above are three-move problems.]

If five points be added to the list printed last month, that list will do for the present month, the relative positions of the first sixteen being unaltered. In the not improbable event of a tie for some or all of the prizes, the Chess-Editor proposes to take advantage of his powers, under "Condition 4," of attempting to decide the ties by "a further trial of skill under new conditions." These will probably include a four-move problem, to appear in the January number, as well as a three-move problem. The latter, in order that it may not be debarred from subsequent publication elsewhere, will be sent by post to the competitors' addresses. It is particularly requested, therefore, that all solvers who have any chance of tieing for any of the four prizes will send, with their solutions this month, the addresses which will find them on or about January 1, or during the last week of December.

## A NOTE ON CHESS THEORY.

Mr. Mason, I think, remarks in one of his books that capture is always, or almost always, followed by reaction. This is especially true when the capture is that of a Pawn; for not only does the player waste a move in effecting the capture, but he also presents his opponent with an aid to counter-attack in the shape of an extra open file. It follows that a player should be careful how he picks up Pawns, more particularly when the capture puts a piece out of play, or in a position subject to attack. Nevertheless, "a Pawn is a Pawn," and among first-class players it is usually numerical superiority that decides the issue. A Pawn, therefore, must be won, but it does not follow that it must always be won at the earliest opportunity. If the attack is strong enough to force the gain of a Pawn, it is generally strong enough to force the gain of something better. When, therefore, you have a Pawn at your mercy, it is often advisable, instead of taking it at once, either to attack it with another piece so as to get the option of taking it with either, or, still keeping hold of the Pawn, to threaten something else; continuing in this manner until you see your way to capture without fear of reaction. On an open board the Queen is especially suitable for tactics of this kind, which really come under the well-known axiom that to threaten is better than to perform. For example, when you have a piece capable of moving to either of two commanding squares, it is often better to play it to neither. If you commit yourself to either, the opponent will at least know what that piece means and will be enabled to shape his defence accordingly; whereas, by reserving the option, you compel him to keep on providing for both emergencies. And, if you can get him into the same state with regard to one or two more attacking pieces, he will probably find that the emergencies to be provided for outnumber his defensive resources, and that consequently his game is lost. In a word, the golden rule for attack may be stated as follows:—"Unless you clearly see your way to decisive gain, *do not make one strong move*, but *threaten to make more than one*."

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